Heating Piping & Air Conditioning

with which is merged the Aerologist

Design, Installation, Operation, and Maintenance: Industrial, Commercial, Institutional, and Public Buildings

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Manager.....Charles E. Price

Production Manager....Lawrence A. Doyle

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THE EDITOR'S PAGES

BUSINESS PAPER GROUP HONORS HPAC's PUBLISHER

At the regular luncheon meeting of the Chicago Business Papers Association on June 13, a beautifully lettered and framed certificate was presented by the association to Frank P. Keeney, president of the Keeney Publishing Co., publisher of Heating, Piping & Air Conditioning, to mark his 50 years' service in the business publishing field.

The certificate reads: "In recognition of the completion of 50 years' service in the business publishing field, and in appreciation of his substantial contributions to the maintenance of the highest standards of business publishing, the Chicago Business Papers Association presents this testimonial of its esteem and affection."

Frank P. Keeney, publisher of HPAC, receives testimonial from Chicago Business Papers Association marking his 50 years of service

HOW TO HEAT LOW RENT HOUSING

Recommendations for the design and construction of heating systems for low rent housing projects are given in a booklet entitled Maintenance Men Look at Housing Design, published by the National Association of Housing Officials as reported on pages 91 and 92 of the February HPAC.

One of the points made in the booklet is that forced warm air convector radiation should be discontinued in such projects because of the cost of maintenance. This statement was based on experience at one of the projects of the Philadelphia Housing Authority with a special type of residential heating unit, and is confusing inasmuch as the type of unit the association intended to refer to is not what is generally known as "convector radiation" in the heating industry.

This statement by the National Association of Housing Officials should therefore not be construed as applying in any way to what is commonly known as convector radiation.

W. H. AUBREY HEADS ACRMA

In three days of meetings at Hot Springs, Va., recently the Air Conditioning and Refrigerating Machinery Association culminated "an unusually successful" year's operations. Speakers at the several ACRMA sessions were in agreement that the coming year was one which would call for the utmost in capable management, practicing every possible economy in production and distribution while aggressively employing the almost-forgotten art of selling in a buyers' market.

"The great market for the products of our industry is still waiting for us," said George S. Jones, Jr., of Servel, Inc., retiring ACRMA president, "but we must re-learn the lessons of the 1930's and go to the market prepared to sell instead of waiting for the market to come to us as it has during the past few years." W. H. Aubrey, of Frick Co., newly-elected association president, said that "the refrigeration and air conditioning industry, with products so essential to the national economy, is at the threshold of the greatest period of growth in its history. But the next year or two will demand many readjustments in both individual and corporate planning and practice if advantage is to be taken of the opportunity. The postwar years have left some of us with too much fat in the wrong places."

Reports to the meeting sessions revealed substantial progress in the many fields in which the association is active. Especially noteworthy was the leading part played by ACRMA in revision of the Safety Code for Mechanical Refrigeration and in the development of standards for both the industry's products and their application. Seven new or revised standards were added to the list of ACRMA accomplishments in this field of engineering. These include water cooling towers for use with refrigerating equipment; room air conditioners; self-contained air conditioners; condensing units 20 hp and smaller; high speed ammonia compressors; refrigeration heat transfer and compression refrigeration systems. These additions will be published and made available to the industry this summer.

Considerable advance was also reported in the development of the association's statistical program.

Officers of the association for 1949-50 are Mr. Aubrey, president; A. P. Shanklin, Carrier Corp., first vice president; Harold F. Smiddy, General Electric Co., second vice president; G. A. Heuser, Henry Vogt Machine Co., treasurer; and Mr. Jones, chairman of the executive committee.

The headquarters office of the ACRMA is in the Southern Bldg., Washington, D. C.

DEVELOPING CODE FOR UNIT HEATERS

The engineering committee of the Industrial Unit Heater Association, 2157 Guardian Bldg., Detroit 26, is now carrying on a series of laboratory tests in the preparation of a uniform code for sound measurement of unit heaters. By cooperating with various organizations interested in developing standards for sound control and sound measurements, the committee is expected to be able to offer a code whose methods are recognized by authoritative bodies. It is planned that the code will be issued by the end of 1949.

HELICOPTER AIDS IN AIR POLLUTION STUDY

The method of studying the distribution and intensity of air pollution has now gone ultramodern, according to the Coal Producers Committee for Smoke Abatement.

For the first time in the history of air pollution abatement methods a helicopter was used in Buffalo to

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THE EDITOR'S PAGES

obtain an overall picture of the pollution hovering over that city.

The city council had to rush through an emergency ordinance permitting helicopters to take off and land within the city limits and to travel at less than 1000 ft.

NARC ADOPTS NEW NAME

A vote by the membership has resulted in the adoption of the name Refrigeration and Air Conditioning Contractors Association for the former National Association of Refrigeration Contractors. The new name, it is felt, "describes more accurately the fields served by the association membership, many of whom are engaged primarily in air conditioning work."

The association office remains at 228 N. La Salle St., Chicago 1.

PROPOSES PROGRAM TO BOOST PRIVATE BUILDING

Stating that the building industry has entered a buyer's market which may reduce the volume of private construction as much as 10 percent this year, Douglas Whitlock, chairman of the Building Products Institute, proposed last month a program for removing the influences which are holding down building activity.

In a talk before the New York chapters of the Producers' Council and the American Institute of Architects, Mr. Whitlock urged manufacturers of building products to support a program to analyze and make recommendations on methods of stimulating a greater volume of private construction.

He charged that strong forces are at work attempting to discredit and destroy the private building industry and said that the industry must work together to protect its interests and answer the critics who use untruthful criticism to undermine public confidence in the industry and the values it offers.

The proposed program also calls for bringing about an increase in the productivity of labor, reducing taxes which add to the cost of building, amending FHA regulations which discourage home building, and enforcing local building regulations so as to remove unsafe, unhealthful, and obsolete homes from the market.

Mr. Whitlock's complete program reads as follows:

"1) Selling the public on the greater quality and value in houses and other buildings being constructed today and removing the public impression that building costs are unduly high.

"2) Amending FHA regulations which discourage home building.

"3) Discouraging national inflationary policies which drive up building costs.

"4) Bringing about an increase in the productivity of labor.

"5) Speeding up revision of local building codes which hold up construction costs and prevent the introduction of new materials and stimulating enforcement of local building regulations, which will remove obsolete homes from the market and thus step-up the demand for new homes.

"6) Reducing federal expenditures for public housing, which discourage builders from building homes and encourage the public to wait for government-subsidized homes.

"7) Revising tax laws so as to encourage greater investment in construction activity and reducing those taxes which add to the cost of building.

"8) Answering critics of the industry who use untruthful criticism to undermine public confidence in the industry and in the values it offers."

N. Y. BUILDING COSTS DOWN 10-15 PERCENT

A 10 to 15 percent drop in building costs in metropolitan New York from the postwar peak of September 1948, was reported last month by a committee of the New York Building Congress. The actual percentage decline in the last eight months varies according to the type and design of the building.

The committee expressed doubt that there will be further substantial reduction in the next year, pointing out that today's bids and cost estimates discount to some extent any further cuts in prices.

SEES HIGH LEVEL OF BUSINESS COMING

The present industrial decline in production may continue until the second quarter of 1950, but business may again reach the high level of 1948 by the end of 1951, Charles E. Wilson, president of the General Electric Co., said last month at the 17th annual convention of the Edison Electric Institute. He said that it was not expected that the present decrease in industrial production would exceed 15 percent, as compared to last year, before production again turned up. He cited the lack of "great speculative excesses in inventories and the stock market," increased government spending, and the piecemeal readjustment of production and prices as factors which would prevent any drastic decline.

In stating that the production of consumer goods in the electrical industry is expected to drop "by at least 20 percent" as compared to last year, Mr. Wilson asserted that "we are now to a substantial degree the victim of our policies of our earned and logical price reductions. We have created a 'wait for more' attitude in our market and the only remedy for that is hard selling of good products at a fair price."

MAY NEW CONSTRUCTION TOTALS $1.6 BILLION

New construction put in place in May was valued at $1.6 billion, a seasonal increase of $200 million over April, according to the U. S. Department of Commerce. With this 15 percent advance, total new construction activity equalled that of May a year ago.

The $6.6 billion total of new construction work done during the first five months of this year was 3 percent above the total of $6.4 billion for the corresponding period of 1948, largely because of increased public construction, according to the department's construction division. Privately-financed construction dropped 6 percent while public expenditures for new construction were 40 percent greater through May 1949 than for the same period of last year.

"OPEN for DISCUSSION"

DO YOU HAVE something to say about any of the articles published this month? An additional comment, or perhaps a question on some point? We follow here the custom of engineering society meetings in allowing a period for discussion following presentation of a paper. You are invited to contribute your views. Address them to the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2

AWARD OF MERIT TO "OPEN FOR DISCUSSION"

The "Open for Discussion" department of Heating, Piping & Air Conditioning received an award of merit last month "for editorial excellence," in the 11th annual editorial competition conducted by the magazine Industrial Marketing.

Presented at a luncheon meeting held during the conference of the National Industrial Advertisers Association at Buffalo, the award covers "special reader comment material published during the period ending December 31, 1948" in this regular monthly department of HPAC.

For Editorial Excellence
INDUSTRIAL PAPERS
1949
AWARD OF MERIT TO
Heating, Piping & Air Conditioning
For special reader comment material published during the period ending December 31, 1948 in the eleventh annual editorial competition
Conducted by
INDUSTRIAL MARKETING

Award of merit presented to HPAC last month for editorial excellence of the material published in "Open for Discussion"

ELECTRIC STORAGE HEATING OF INTEREST

The article by W. Bruce Morrison in the June HPAC describing an electric storage heating installation in a school building located in an area within the Bonneville Dam electric distribution system covers an interesting adaptation to meet special conditions and to take advantage of unusual opportunities. The Bonneville Dam project is one of several that are able to furnish electrical energy at comparatively low rates because of public aid. Without entering into any discussion of the propriety of people in Illinois being taxed to make possible low electrical energy rates in Oregon, it can at once be admitted as sensible for those in that area to take whatever advantage can be had from their opportunity.

I am one who believes that in the not too far distant future a large part of heating in the United States will be done by electricity. When and where electrical energy rates are low enough so the total seasonal cost for heating by electricity approaches that by other fuels, electricity will be the chosen medium for providing comfortable indoor temperatures. We have all been interested in the research and trial of heating homes by electrically heated panels. Technical papers have been written within the past year on this development and reports indicate that with electricity selling at ½c per kwhr or less, the cost of heating by electricity appears to be not too far out of line compared with costs by using the more common fuels. As electrical rates come down, convenience and cleanliness of electric heat will bring about more and more such installations.

In the heating installation as described by Mr. Morrison in the school at Cascade Locks, a water storage tank has been substituted for the usual boiler and fuel burner installation. It appears from the description that water is drawn from the storage tank at a temperature of around 200 deg at the outlet and circulated through coils in the concrete classroom floor slabs and through coils for warming air for ventilation somewhat as is typical in a hot water heating job. A more complete description of the controls to keep water in the floor coils from becoming too warm would be helpful. It would be interesting to know how the original cost of the unique system designed and installed in the Cascade Locks school compares with the cost of a typical hot water panel heating system using a conventional boiler and fuel burner installation. There is usually considerable saving effected in the elimination of the boiler, boiler room, fuel tanks, smokestack, etc., part of which must be charged against the cost of the storage tanks and electrical resistor units. It would be interesting to learn, too, how rapidly the electrical resistor units in the storage tank depreciate through the years and whether or not there is any water conditioning problem in keeping the tank and resistors clean and free of deposit.

The storage type of electric heating system does make it possible to draw energy from the public utility lines at offpeak periods, which gives this system a great advantage over a system heating by electric radiant panels. The load diagram with the article indicates that on January 8, for example, the only current drawn from the public utility lines for heating the school was at the offpeak period between 11:00 p.m. and 7:00 a.m. at which time it was nearly half the whole utility load. This would mean of course, that the temperature of the water in the storage tank would gradually fall all through the school day with the need of constant regulation of the amount of water being recirculated and that taken from the storage tanks.

The whole project is an interesting one that could add valuable operating data to a field that seems to be growing of more interest each year.—JOHN HOWATT, chief engineer, Chicago Board of Education, and member of HPAC's board of consulting and contributing editors.

HOPES FOR REPORT ON AIR STERILIZATION

In his comments in the June issue on my May article on air sterilization, Prof. Wells has rightly drawn attention to the steps being taken to rationalize the situation with regard to air sterilization in this country. His pioneer work is recognized by all. It is to be hoped that

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"OPEN for DISCUSSION"

a report can be published in this country similar to the British special report No. 262 to which he refers. It would serve to gather in one place a great deal of information which is at present scattered through journals published by several organizations—medical, public health, and engineering.

Special Report No. 262 of the Medical Research Council, entitled Studies in Air Hygiene, is available in this country through the British Information Services, 30 Rockefeller Plaza, New York 20 (price $2.20, postfree). Those interested scientifically or commercially in the subject would do well to study this comprehensive report which covers methods of sampling air for bacteria; air disinfection by chemicals, by ultraviolet radiation, by heat, and by recirculation through filters; masks, etc. A comprehensive bibliography is included.—CYRIL TASKER, Cleveland.

BACTERIA REMOVED BY DEHUMIDIFIERS

I want to compliment Cyril Tasker for drawing attention to the importance of further study of the means for air sterilization in his Summary of Methods for Sterilizing Air, published in the May issue of HPAC.

There is a definite trend in this country to use solid adsorption dehumidifiers in combination with refrigeration after cooling for air conditioning in areas which have a high latent load. This method makes it possible to maintain an ideal effective temperature in conditioned spaces with less temperature differential between outside and inside than is customary with conventional designs.

Research in connection with package solid adsorption dehumidifiers and the results which have been obtained in some initial tests on bacteria removal from air by means of desiccant dehumidifiers are so promising that a further study of the efficiency of this type of equipment for removing bacteria from the air certainly is justified.

It is to be expected that the desiccant bed is a good bacteria filter and reactivation air destroys the filtered bacteria.—GUNNAR ASKER, Daly, Merritt & Sullivan, Inc., Washington, D. C.

IS IT PANEL OR RADIANT HEATING?

I noted in the April issue an article entitled Call It Radiant or Panel Heating? I think it is high time for this question to be settled, and it does seem to me to be a relatively simple matter to determine the proper terminology.

For this purpose, it would appear that the dictionary should be the authoritative source for information as to the suitability of terms. From this source the term "radiant heating" seems to be the correct expression, and "panel heating" is an incorrect use of the word "panel," unless the area radiating heat is a part of a larger surface.

Hence, a uniformly heated floor or ceiling should not be termed "panel heating" but "radiant heating." "Panel heating" is a subdivision of radiant heating where the heat transmitting surface is a definitely localized area encompassed or associated with a larger area, normally not functioning as a primary heating surface.—RICHARD W. SHOEMAKER, consulting engineer, Oakland, Calif.

"QUOTE"

"Experience has proved that there is no 'miracle' method of eliminating smoke. It requires intelligent and continuous work toward improving the methods of burning fuels of all kinds and types. The problem can be solved only by a scientific approach . . . the finding of the real sources of pollution and the engineering 'cure' for each source. It is a long-term project which requires the effort of all interested citizens. It can never be solved by high pressure publicity and exaggerated statements. It can only be accomplished by sound engineering. Each plant presents its own problem and until the public comes to realize that it is an engineering problem and one that cannot be solved tomorrow morning, or next week, it will be impossible to obtain the necessary continuous and uninterrupted cooperation and assistance."—JAMES E. CAMPBELL, smoke abatement engineer, Charlotte, N. C.

STRETCHING DEHUMIDIFIER PERFORMANCE

Referring to Peter Franck's rebuttal in the May issue to my April comments on his article, Stretching Dehumidifier Performance, which appeared in the March issue, my comments were directed to the use of the word "stretching." Actually, it is a matter dealing with choice of words and deals in personal opinion rather than factual data.

The fact is that Mr. Franck's analysis in his article was quite correct and we have no real point of argument.

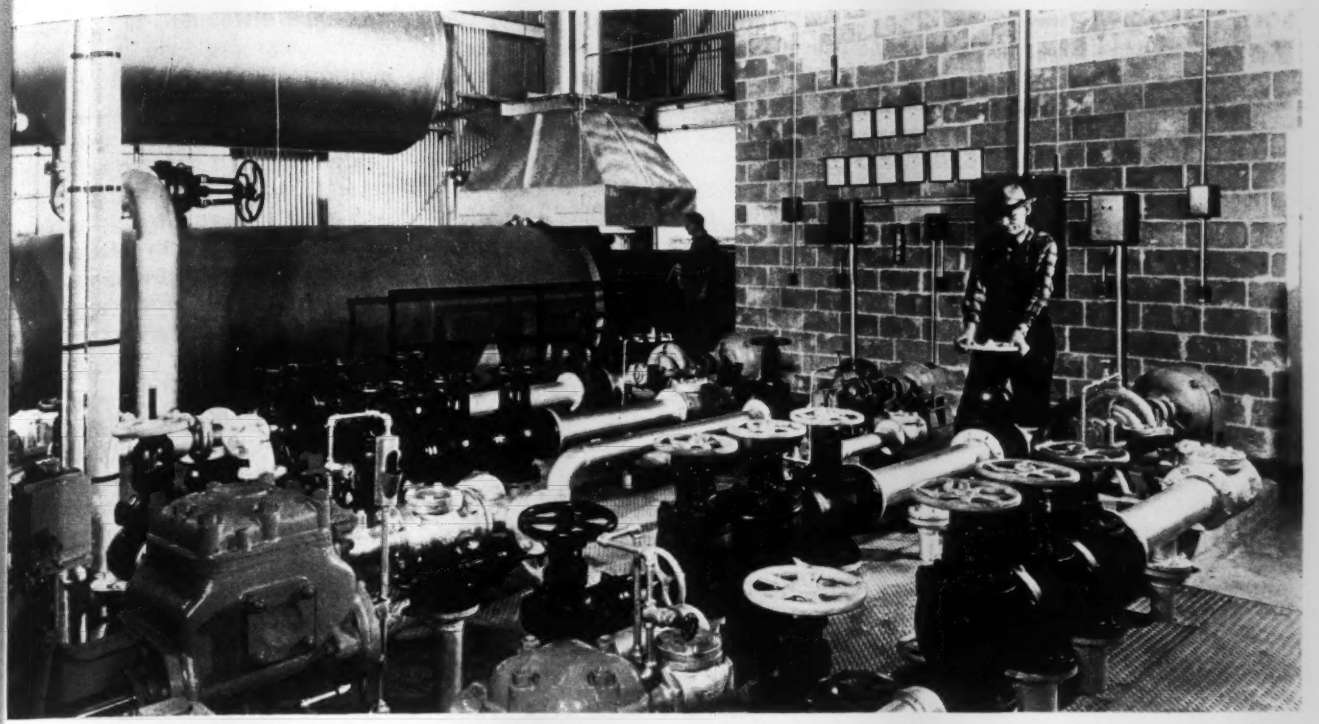
My point in using the counter example was to point out that there are other ways to accomplish drying jobs resulting in more capacity than by the method used in his article. The factors which determine the proper method to use are dictated by the problems of each installation.

Mr. Franck's article was a worthwhile contribution in this field—H. W. HEISTERKAMP, manager, air dryer dept., Bryant Industrial Div., Affiliated Gas Equipment, Inc., Cleveland.

MIT OFFERS "ENGINEER" DEGREE

A new terminal degree for practicing engineers, to be called the "Engineer" degree, has been approved at the Massachusetts Institute of Technology. The new degree was awarded for the first time at the MIT commencement this June. It requires about two years' study following a bachelor's degree in any one of the institute's various engineering departments.

When the field of specialization is to be indicated, the engineer degree will be referred to as follows: civil engineer, mechanical engineer, metallurgical engineer, electrical engineer, building engineer, etc.



The operating room is like a ship's engine room, and operation is simplified by the use of different colors for the valve handwheels. The valve wheels are knee-high for operative efficiency. A sight flow fitting made of two pieces of pipe, several of which were used on the job, is shown in the left side of this picture. The plant is an industry "showplace"

Modern Wood Preservation Depends on Proper Piping

E. L. BEISSER, engineer, and W. M. BARNES, construction superintendent, American Lumber & Treating Co., describe the new Everett, Wash., plant, which is a "showplace of the industry" —with particular attention to the piping. A number of practical piping pointers of interest and value to those concerned with piping design and installation for numerous industrial processes are included in the discussion, not the least of which is the explanation of how quite a bit of piping drafting time was saved

MODERN WOOD preservation is a complex and exacting industrial science. The end product, pressure treated lumber, is chemically protected against decay and termites and is widely used as structural lumber in bridges, roof decking, foundations, grandstands, and home and farm construction as well as being used for telephone poles, marine piling, and railroad crossties. Practically any species of wood can be successfully impregnated with wood preservative solutions and so rendered highly resistant to attacks from decay fungi and termites.

To penetrate wood deeply enough to give lasting preservative protection, modern treating methods require extensive piping services and apparatus. The main element in a treating plant is the cylinder, which varies in size from 90 to 180 ft in length and is generally 6 to 8 ft in diameter. Small gage tracks in the cylinder or retort permit loaded trams to enter. Removable tracks connect the cylinder to the plant railroad. When enough trams are loaded with lumber to be treated, a "charge" is formed of from 10 to 15 trams. The plant locomotive shunts the charge into the cylinder, the temporary tracks are removed, the cylinder door is bolted tight, and treatment begins.

Joined to the retort in various positions are the pipe lines vital to the treating process. Lines for developing vacuum in the retort, steam lines, lines leading the solution in and out of the cylinder, and compressed air piping comprise these services. The solutions may be either creosote, creosote-petroleum mixes, or clean waterborne chemicals, such as "Wolman" preservative salts. Techniques of appli-

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cation for each of these solutions vary only in detail; the principles of pressure-treatment have been standardized by the American Wood Preservers' Association, and precise retentions of chemicals in treated materials are well established. Approximately 310 treating plants operate in the United States, providing railroads, contractors, and building material suppliers with decay and termite proofed products of the lumber industry.

An example of pressure treating techniques is that followed in producing lumber impregnated with a clean preservative. First the material is subject to a steam bath. Then a vacuum is created in the cylinder and the solution is introduced at temperatures of 90 to 100 deg. When the cylinder is filled, pressures ranging from 125 to 175 psi (depending on wood species) are developed by pumps, so that the solution is forced into wood cells and fixed to fibers. By checking floats and pressure gages the operator knows when a specified chemical retention has been reached, after which he releases the pressure by stopping the pumps and draining the retort. Another short vacuum is pulled to remove excess moisture on the wood surface. Treatment at this point is completed.

Everett Plant Is a "Showplace"

One of the most modern treating operations of the day is the American Lumber & Treating Co.'s new plant at Everett, Wash., in the heart of a large lumber production area. This plant is a "showplace" in the wood preserving industry, featuring several new departures in construction methods. Its two treating cylinders are 132 ft in length and 6 ft in diameter—one for oils, one for clean preservatives.

Welded throughout, these two retorts have shell plate thicknesses of 1 in. steel to withstand 200 psi. A four pipe manifold system between tracks and on the floor of the vessel heats the cylinder. Steam coils are also provided in each of the storage and mixing tanks to preheat the preservatives.

The operating room at Everett is like a ship's engine room. The maze of pipes, valves, steam and air lines, pumps, condensers, and gage boards are easily accessible on one floor level. Operation is simplified by the use of color on valve wheels. Creosote controls are black; salts, yellow; steam, red; and air, blue. Piping has been laid below floor grids, which are removable for any necessary repairs. Valve wheels are knee-high for operative efficiency. Gage boards stand next to the proper cylinder, each of which has been installed at the extremities of the treating room. An office and laboratory are located inside the plant building, where quick analyses may be made of the chemical concentrations. All the operating equipment is in the center of the room between the cylinders.

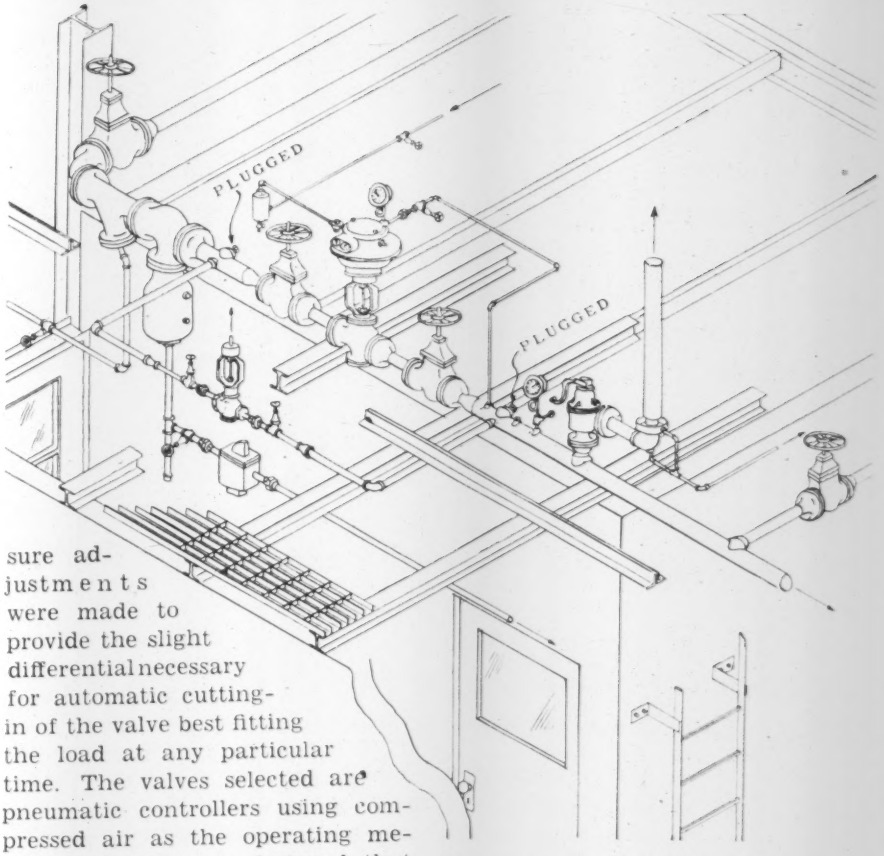
An interior view of the completed treating room is shown on the front cover this month. The gage board in the background of the picture gives an immediate check on the treating process, which in this photograph is creosoting. The lower cylinder is the treating retort, and over it is the Rueping tank. Both are of all-welded construction. In the foreground of the picture are pipe manifolds—one for salts and one for creosote but both interchangeable if desired.

Steam Demand Varies Widely

Wood preserving operations, in common with many other so-called "batch" or "charge" type processes, present highly varying demands for steam. A typical first-stage treating cycle may require that live steam be introduced to the retort; in the next cycle no steam is required; following this, steam is required for heating with coils. This intermittent usage of steam, repeated for each charge and for two retorts, results in a flow chart record which resembles, at times, a profile of the Rocky Mountains—varying from 0 lb per hr valleys to 10,000 lb per hr peaks, with comparatively few plateaus interspersed.

No difficulty was encountered on the supply side of the steam problem. Boilers of the Weyerhaeuser Timber Co.'s saw mill operation adjacent to the treating plant site provide ample capacity, and steam is purchased. The receiving side, however, is somewhat more complicated. A new steam line was required to connect the boilers to the retorts and other steam actuated equipment of the new plant—some 2100 ft distant. This line was installed partly through existing mill buildings and trucking tunnels and partly through open yard areas, thus requiring many ingenious arrangements for hanging and supporting the line and for ridding it of condensate. Standard weight, 4 in. wrought steel pipe was used, the line being welded throughout. Expansion joints are of the rectangular U type fabricated from 90 deg welding elbows and pipe. Covering for the line consists of 2 in. thick, 85 percent magnesia, sectional pipe insulation, weatherproofed with a layer of two ply 45 lb roofing paper.

Piping from creosote storage tanks to treating cylinder is suspended from concrete footings on U-bolts to compensate for possible ground settlement. The plant is built on filled-in earth.



The pressure reducing station. Flanged connections are used through the main line with filler pieces provided for convenience in removing valves for repair; extra heavy (250 lb) flanges are continued through to the relief valve, from which point standard (125 lb) flanges are used in reduced pressure piping. The relief valve provides protection for 125 lb valves and fittings, upstream, during periods of negligible steam flow when unavoidable leakage is apt to be enough to build up full line pressure. Provision is made for quick installation of a hand operated bypass (plugs) around the reducing valves, but the hand bypass is not permanently connected. Top work for one of the regulating valves is not shown but is similar to and the piping connections are same as those shown for the other valve

and held in place with No. 16 ga galvanized wire bands.

Of perhaps greater consequence than the problems connected with the installation of the line itself were the requirements of providing for close control of flow and uniform pressure at the distributing end. Supply pressure at the boilers averages 155 psig and the required controlled pressure is 115 psig. The equivalent length of 4 in pipe for calculation of pressure drop is 2300 ft.

Selection of Pressure Regulators

For the selection of pressure regulating equipment, some indication of the range of terminal pressures under various conditions of demand was needed and calculations were made which showed the following results:

Steam flow, lb per hr	Press. drop, psi	Terminal pressure, psig
10,000	29	126
5,000	9	146
3,000	3	152

Pressure reducing valves were selected accordingly. It is interesting to note that calculated terminal pressures were very close to actual operating pressures, checking within 1 psi.

Following the axiom that "with reducing valves it is desirable to select a size that is loaded somewhere near capacity under normal operation," it was decided that two valves would be needed to meet the varying flow conditions. A 2½ in. valve having a capacity of 8000 lb per hr and a 1 in. valve having a capacity of 2400 lb per hr were connected in parallel. Controlled pressure adjustments were made to provide the slight differential necessary for automatic cutting-in of the valve best fitting the load at any particular time. The valves selected are pneumatic controllers using compressed air as the operating medium. They are so designed that should the air supply to the pilot portion or topwork of the valve fail, the main valve closes. The accompanying sketch illustrates the general assembly of valves and piping for the reducing station.

Protecting Piping from Settlement

An interesting technique in piping construction was caused by peculiarities in the terrain, which is soft and spongy. Creosote storage tanks are erected on concrete bases supported by 40 ft creosoted pilings driven in the ground and are surrounded by a concrete fire wall. Reinforced concrete 12 x 12 beams add support to the bases and extend between bases and between walls and bases. Eight inch pipe lines from the tanks to the treating cylinder are entirely of welded construction and are underground.

To provide for ground settlement which might cause damage, U-bolts were fixed below the concrete footings and pipes were suspended from them. Further protection was given by corrugated flexible pipe connectors that compensate for settlement. Similar connectors were placed on underground pipes from the "Wolman" salts storage tanks but instead of using U-bolt supports, these pipes were laid on creosoted ties. All underground piping is protected externally against soil corrosion by heavy applications of asphalt mastic coating.

Manifold System for Pumping Solutions

Another unique piping feature is the manifold system for pumping solutions between storage tanks and cylinders. This is a prefabricated system employing cross and angle valves and piping headers in a neat, compact, low cost unit. Prefabricated pipes measure 8, 6, and 4 in. and are used in vacuum lines as well.

At Everett, provisions were made to carry off creosote fumes when the cylinder door is opened after treatment. Experience with the construction of the company's nine other plants proved that an exhaust system permits more rapid movement of a charge from the retort and adds considerably to worker comfort. The ventilation is simple, consisting of a hood, 27 in. fan, and duct work extended over the cylinder door. The fan is switched on a few minutes before a charge is "pulled" and discharges the acrid creosote vapors through the duct work. The fan's free air delivery rating is 9200 cfm.

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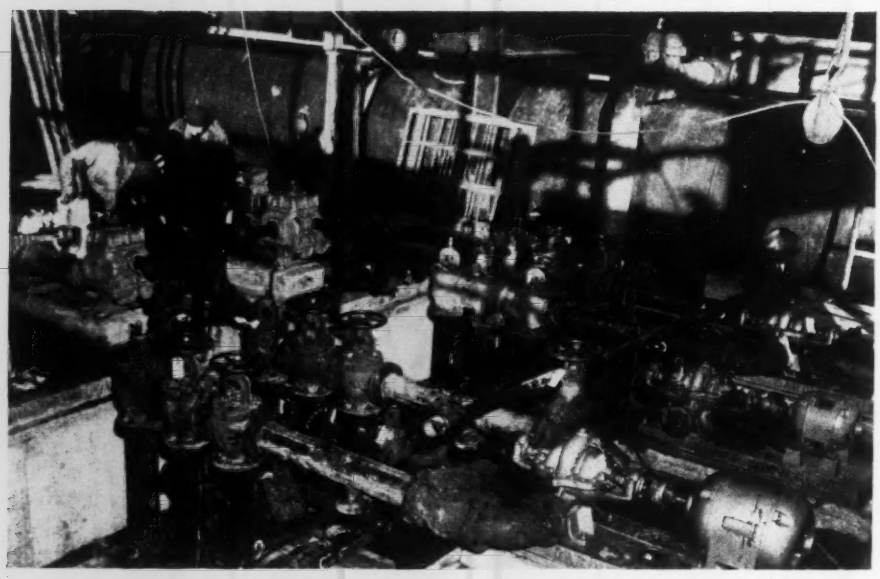


A construction view of the pump manifold in the treating room, through which creosote and salts solution are pumped in and out of cylinders during pressure treating processes. In background, workmen tighten bolts in steam reciprocating pumps which are used to build hydraulic pressure in the treating cylinders. In foreground are the high speed centrifugal fill pumps

Engineers concerned with the "drawingboard phase" of piping layout work may find the process used in preparing working prints for the Everett plant piping job of some value. Certain of the lines in the design of any process piping layout require greater detail than others. In the case of a treating plant, the preservative solution lines and associated pumping manifolds, the vacuum lines, and the condenser water supply and discharge lines, are of primary importance and generally require complete dimensioning. The main and branch steam lines, condensate lines, compressed air lines, vents and drains, are of lesser importance, but still must be shown in relation to the overall layout.

How Piping Drafting Time was Saved

To do this with a minimum of drafting time, the following scheme was employed. A master tracing was prepared which showed a plan view of the building, the locations of all equipment, and all outlets to which piping would be connected. The more important pipe lines mentioned above were then added. No labelling or dimensioning has been done to this point, and the title block of the drawing is left blank. Prints are now made from the master tracing, these prints being of a type which are made directly on sensitized tracing paper. In other words a tracing is made from a tracing. As many of these "first printing tracings" can be made as are judged necessary to later show the piping of lesser importance.

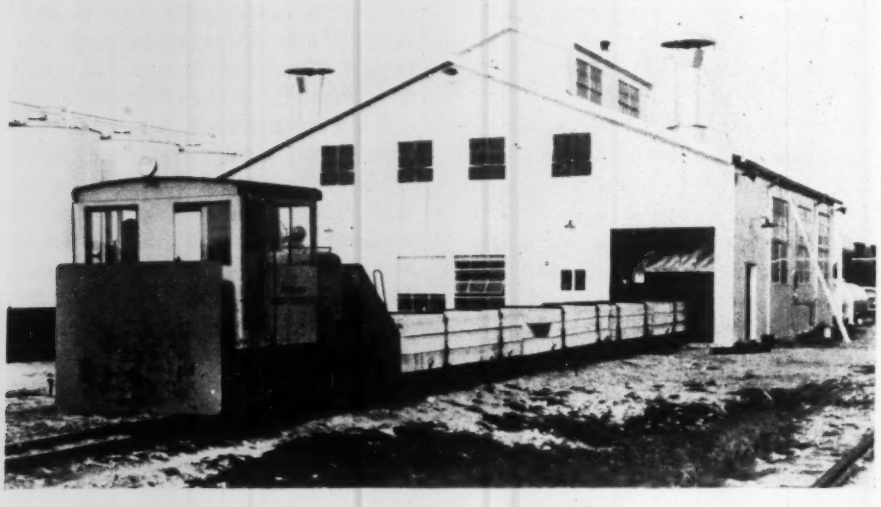
Now the master tracing can be completed—marked for section reference, dimensioned, and clarified by notes and material identification symbols or schedules. The "first printing tracings" are ready for additions at any time.

For the design work in connection with the Everett plant piping, it was found that two of the "first printing tracings" were sufficient. On one of them was shown the steam, condensate, and exhaust lines; on the other, the domestic water, compressed air, and process blowdown lines. These new lines were added in pencil, superimposed of course over the original work already appearing. Notes, dimensions, and legends applying only to the newly drawn piping systems were added. In the final printing—blueprinting was used—the penciled additions to the "first printing tracings" stood out boldly with the major piping subdued, but still clear.

This method of reproduction makes it possible to have separate drawings for each of a number of piping systems—each with its own dimensions, notes, etc., and each related to the general building and equipment plan. It is necessary to prepare only one plan of the building and equipment, thus greatly reducing the drafting time required. Much of the confusion resulting from showing a number of systems on one drawing is eliminated.

Bumstead-Woolford, Seattle, was the piping contractor on this job.

The plant locomotive shunts a treating charge of bridge timbers into creosoting cylinder for preservative treatment. Note two roof stacks which come from ventilating system, and are used to carry away fumes and steam when cylinder doors are opened after treatment



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HERE'S A NEW HAZARD TO WORRY ABOUT!

Outside the bar at the Hotel Statler in Detroit last month during the convention of the Heating, Piping and Air Conditioning Contractors National Association, we overheard a man with a bandaged foot explaining how he got hurt. Seems he was getting a large chunk of roast beef out of his home freezer and it slipped from his hands.

Contractors Mark 60th Anniversary of HPACCNA at Biggest Convention

THE ANNUAL CONVENTION of the Heating, Piping and Air Conditioning Contractors National Association in Detroit last month started off with a pageant depicting six decades of development of the industry and the HPACCNA, progressed through presentation of many committee reports, discussions, and informal roundtable sessions, and concluded with the installation of the officers who will guide the association's affairs for the coming year

TERMED THE largest in its 60 year history, with a total registration of over 775 members, guests, and ladies, the annual convention of the Heating, Piping and Air Conditioning Contractors National Association started off with a bang last month in Detroit with the presentation of a pageant depicting six decades of progress in the past and predicting many more decades of usefulness to the public in the future. A number of boiler and radiator manufacturers contributed toward making the pageant possible; it involved many months of work and (we suppose) the expenditure of a sizable amount of money.

Start Off With Pageant

In forceful "March-of-Time-style," two announcers at microphones in the meeting room alternated in giving general news highlights, fashion notes, and comments on the development of heating and air conditioning equipment. Popular songs of the time furnished the musical background, and appropriately gowned models unveiled photo murals for each decade. Authentic photos of equipment had been dug out of old files, and these were supplemented by news pictures to form the murals. Of particular historical interest were the old foot radiators, dining room radiators of many shapes and sizes and equipped with warming ovens, old boilers, and so on.

Following the pageant, the convention got down to more serious matters with an address by Cloud Wampler, president of Carrier Corp., who spoke on business conditions in the industry.

Good Year for Air Conditioning

Air conditioning is still in its infancy, he said, and he expects that 1949 will be a good year for air conditioning—perhaps 15 percent under 1948. The construction industry is apt to fare better than general business this year, he feels. According to his figures, private construction for May 1949 was but 9 percent under the May 1948 total, and public and private construction for the first five months of 1949 was up 3 percent over the first five months of last year.

He termed the current business situation a period of readjustment, and said that Americans should not confuse "a good, old-fashioned competitive era with a depression."

"Of course," he said, "this involves some belt-tightening. But this is hardly surprising after a protracted period in which everything—production and consumption, prices and wages—all have been spiralling steadily upward. Certainly a correction at this time is healthier than would have been a continuation of the soaring spiral. For in that direction lay certain trouble."

Mr. Wampler predicted that a floor has been built under prices, and that "we will never again see price levels that are as low as those of only a comparatively few years ago." He expressed the belief that although some prices were in for further readjustments, there would be no great retreat.

New Plateau Established

"It seems more than likely that a new plateau of long duration has been established," he said. "And once prices are stabilized at something approaching this level, then a lot of latent buying power will come out of hiding and business will pick up again.

"My principal reason for believing that prices will not retreat greatly is that our whole national debt and expense structure absolutely requires the maintenance of a cheap dollar. Then there is another important angle. Wages are the biggest single element of cost and are not apt to work materially lower."

The current business situation may well continue into the early months of 1950 before there is a marked upswing, Mr. Wampler said, but he added that even at lower levels this should not be considered as a period of poor business.

Under existing conditions, he said

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he did not expect there would be any general fourth round of wage increases.

Asserting that "once we get down to real competitive trim there is a whale of a lot of business to be done, now and for a long time to come," he expressed a belief that "our one great danger lies in an extension of the political philosophy of tax and tax and spend and spend, always with the basic thought of spreading the power of government, of making both individuals and business concerns more and more dependent on government and, in turn, throwing government more and more into business."

Speaking of the future he said he foresaw "a severe or prolonged depression only if government relies solely on its spending power to turn the tide and refuses to take those actions which will re-activate and re-invigorate the factors making for expansion in the private sector of the economy."

Air Conditioning Standards Published

William S. Bodinus, Chicago, chairman, reported that the committee on air conditioning had completed its assignment with the publication of the new fifth edition of Part IV of the HPACCNA's engineering standards, on comfort air conditioning. This 63 page booklet will be mailed to all members, and is available at "nominal cost" to others from the headquarters office, Suite 1401, 1250 Avenue of the Americas, New York 20.

The booklet is essentially a compilation of proved data from authoritative sources, and the information is the best currently available, in the opinion of the committee. The latest psychrometric chart—not materially different from previous charts—is included, as is a high temperature psych chart. There is a list of application and installation codes, a section on psychrometric relations, and a thorough discussion of load calculation procedure with the calculations and explanations given in some detail. A cooling load estimate sheet shows the necessary calculations.

Tables in the booklet give the properties of air, water, and steam; air, ice, and steam; inside summer and winter conditions; outside design conditions; heat gains; ventilation standards; data for calculating heat gains through sunlit and shaded walls; solar transmission through glass; factors for shading devices; city water temperatures; pipe sizing data; etc.

Aim of the committee was to include in the booklet complete information for the engineer and estimator to avoid the necessity of searching through various sources. The data are not intended to apply to industrial air conditioning.

Antifreeze Solutions in Radiant Heating

Indiscriminate use of antifreeze solutions in panel heating and snow melting systems is a problem that is currently being analyzed, said Peter B. Gordon, New York, in his report as chairman of the radiant panel heating committee. He said there was a "slight danger" in such indiscriminate use, but detailed information was not ready for release. Most such solutions are of the glycol family and are not corrosive but tend to become corrosive. Therefore, inhibitors are added and it is not too certain what happens when such solutions lie dormant in a piping system for some time. A check should be made every two or three years on the anticorrosion properties of the solution in a piping system, he stated.

Temperatures of 300 deg and thereabouts tend to break down the inhibitors. Because of this, the water and antifreeze mixture for a panel heating or snow melting system should not be heated in a boiler but a heat exchanger should be employed to avoid creating a local temperature as high as 300 deg.

He said there was no difficulty with antifreeze solutions from the flammability or products of combustion standpoints, but that back contamination of the water supply was a serious question. There should be no connection between a system using antifreeze and the water supply.

Mr. Gordon mentioned the extensive studies of panel heating being conducted by the American Society of Heating and Ventilating Engineers, to which the HPACCNA (as well as other groups) has contributed materially.

In his report as chairman of the committee on trade promotion, Gustav Nottberg, Kansas City, said that designing and installing snow melting systems for driveways, docks, ramps, sidewalks, and even hazardous streets was "a limitless field which needs only to be tapped." He mentioned also panel and baseboard heating as the contractor's great selling points in the residential field. Sale and installation of unit heaters in drug stores, restaurants, and department stores in order "to save valuable floor space" is also a good potential market, he stated.

Fields which present "good possibilities of exploitation" are industrial air conditioning, code welding on all jobs, power and process piping, and diesel engine piping.

He reported the results from a questionnaire answered by 277 contractors, which showed an average volume of annual sales of $953,092, a 5.07 percent profit after taxes, and a turnover ratio of 5.5.

The contractor's business must be set up to operate as efficiently as possible; study should be made of detailed cost records; there should be emphasis on complete "take offs" when estimating a set of plans (avoiding lumping certain phases of the work), old, obsolete tools should be replaced with new, efficient, speedy equipment; jobs should be properly prepared and started in the main office and not by the workman in the field; and "men, tools, materials, and plans must meet on the job."

He concluded his report by saying that, in the interests of economy, efforts should be made to bid mechanical work direct to the owner rather than through the general contractor. Separate bidding is not only beneficial to the heating, piping, and air conditioning contractor but also to the owner, he said, as it does away with pyramiding of costs. It also takes the mechanical contractor's "eggs" out of the general contractor's "basket."

Put Bargaining on "Equitable Basis"

Called by John Zink, of Baltimore, "one of the most important matters of policy ever to come before the HPACCNA," a resolution adopted unanimously at the concluding session of the convention in effect called upon the United Association of Journeymen and Apprentices of the Plumbing and Pipe Fitting Industry to revoke the res-

olution recently signed by the UA and the Refrigeration & Air Conditioning Contractors Association (formerly the National Association of Refrigeration Contractors), in order that bargaining regarding wages and working conditions in the refrigeration and air conditioning field will be "on an equitable basis." According to Mr. Zink, there was a feeling in some circles that the UA resolution (reported on page 69 of the May issue of HPAC) was not in accord with local autonomy agreements and the rules and bylaws of the UA itself. It is a complex question, he said, and all the answers couldn't be given at the present time; however, the officers and directors of the HPAC-CNA would study the situation and take every step that was reasonable and fair. He said that the HPAC-CNA was opposed to the refrigeration contractors being set up as separate entities in bargaining with the journeymen.

New Officers and Juniors

The convention concluded with the installation of the new officers for the coming year, and the announcement that the 1950 gathering will be in San Francisco, May 8 to 12, at the St. Francis Hotel. The 1951 convention will be held in Washington, D. C.

The new president of the HPAC-CNA is L. L. McConachie, Detroit, who succeeds Thomas L. Eagan, of Washington, D. C. The new vice president is Wray M. Scott, Omaha, and the treasurer is H. E. McGregor, Cambridge, Mass. Joseph C. Fitts, New York, is the association secretary. Joseph H. Spitzley, Jr., Detroit, announced the new officers for the national junior association of the HPACCNA as David A. Forberg, Chicago, president; William Spohn, Akron, vice president; Kenneth A. Leitgabel, Elm Grove, Wis., secretary; and Donald McConachie, Detroit, treasurer.

Formal entertainment during the convention—and it was supplemented by a lot of informal entertainment—included a "night-cap party" the evening before the first convention session, a get-together boat ride party, a dinner dance, and numerous activities for the ladies. In addition, the juniors had an afternoon meeting, two luncheon meetings, and a dinner.

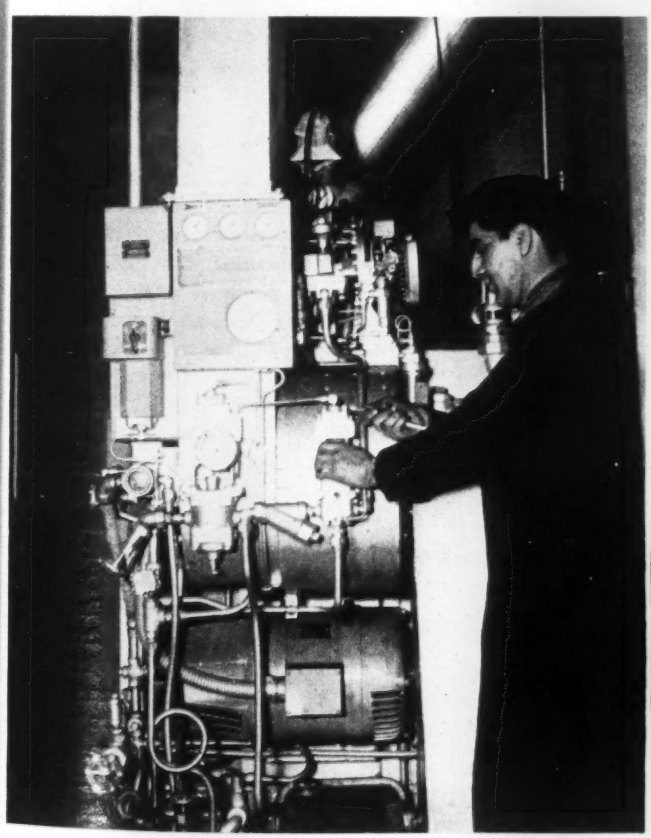
The other committee reports and discussions will be covered in a second article, as will the informal roundtable session on pipe welding.

TECHNICAL TRANSLATORS DIRECTORY ESTABLISHED

Solution of a long-felt need in connection with the recurrent problems of locating persons with special language skills for translating scientific and technical articles is forecast in the announcement of the establishment of a directory of translators by the science-technology group of the Special Libraries Association, 31 E. 10th St., New York 3. The directory is operated as a free service to bring together clients having translation problems and language specialists competent in various subject fields in science and technology, and is housed at the Southwestern Research Institute, San Antonio, Texas, under the management of Librarian Wayne Kalenich.

Individuals or firms needing qualified translators are invited to address inquiries to Mr. Kalenich, and translators are urged to place their qualifications on file with the directory.

Steam Generator Cars Heat Passenger Trains



The Canadian National Railways has built two all-steel steam generator cars for service on its lines in Prince Edward Island. These specially-designed, self contained cars supply heat for passenger trains hauled by diesel-electric locomotives. Each of the cars can supply 3000 lb per hr of steam, sufficient to heat an eight to 10 car passenger train.

Equipment contained in the cars includes an oil fired boiler (shown here); a diesel engine and generator; an air compressor; two 1100 gal capacity water storage tanks; a 24 volt battery for emergency lighting and for diesel engine starting; and a 325 gal capacity fuel tank.

The cars are equipped with modern trucks for passenger train service, and are finished in the standard C.N.R. passenger car green with gold lettering.

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District Heating Reports Good Year; Finds No Slackening of Steam Sales

By John F. Collins, Jr., Secretary-Treasurer of NDHA

PRESIDENT HENRY L. MARTIN's address at the opening of the 40th annual meeting of the National District Heating Association, held recently at Swampscott, Mass., included a powerful warning "to guard against big government, which we cannot regulate, rather than against big business, which we can control."

Mr. Martin, who heads steam sales and service in the Boston Edison Co., said that in our normal way of life, competition is a dominant force. We have passed through an abnormal period and we face a time when competition will again return; we should welcome it, and the necessity to get on the firing line to show what we can do. The luxury market requirements generally have been met and business must emphasize more basic products.

When competition ceases, Mr. Martin said, it is due either to the fact that we are at war and under temporary restriction from central authority or that our movements and operations are so closely regulated under permanent restrictions that our every action is planned, not by ourselves but by others. We can choose independence and competition or lose our independence and competition will cease. But what could take the place of either?, he asked.

Mr. Martin said that there is no indication in the district steam business that steam sales are slackening. Steam prices are not receding; in fact, many companies have increased their steam rates without serious loss of business. However, the industry should be prepared for the change to "normalcy."

Membership in the association is higher than at any time since before the war. Membership chairman Leonard S. Phillips, New York Steam Corp., announced the granting of a charter to the new New England section of the association.

The continued rapid increase in district heating was shown by the reports compiled by the operating statistics and sales development committees. E. T. Smith, The Detroit Edison Co., chairman of the former committee, to which 57 large steam utilities supplied statistics, said that for 1948 there was an increase in steam sales over 1947 of 3.12 percent, probably almost wholly accounted for by the normal amount of new customers added during the year, since the number of degree days was almost identical with that for 1947. On a company average basis there was a degree day decrease of only 0.34 percent.

Statistics Show Industry Progress

Total revenue of the reporting utilities increased from $50 million in 1947 to about $59 million in 1948 or 18 percent, with only four companies reporting a decrease. The total average revenue or rate per 1000 lb of steam sold increased from 94 cents to $1.08 or 14.8 percent, with only three companies reporting decreases.

Fuel costs continued to rise in 1948. Coal cost per million Btu rose from about 26 cents in 1947 to 31 cents in 1948 or 19.2 percent, and oil from 35.5 cents to 50 cents, or 41 percent. Other fuels varied but little and Mr. Smith was of the opinion that the peak had about been reached.

There was an increase in employment and in wages in 1948, resulting in an average increase in total hourly wage cost of 14.24 percent.

According to the report there was an increase of 1.84 percent in the amount of distribution mains and services on the basis of square feet of external pipe surface.

The increase in capital investment during 1948 was 5.13 percent and new investments proposed for 1949 are 14.93 percent greater than the 1948 total. Thirty-two utilities propose to spend $8 million this year.

Many of the utilities still need to make upward adjustments in their rates. A study of the 1948 statistics of 37 of the reporting companies reveals that 26 of them use more than half their revenue for fuel.

Of 51 large heating utilities reporting sales statistics to Sterling S. Sanford, The Detroit Edison Co., of the sales development committee, 42 obtained a total of 964 new customers in 1948 compared with 1125 obtained by 40 reporting companies in 1947. For the 42, the estimated annual steam consumption and revenue from new business are 2,747,429 M lb and $3,164,002 compared with 2,733,850 M lb and $2,689,097 for 1947. Nine companies added no customers to their lines.

In four cities, the incidental increase in electric revenue of affiliated electric companies due to closing down combination steam and electric plants with the taking of steam service was $62,970 in 1948 compared with $20,300 in 1947.

Among the 964 new customers were 255 old buildings which at some previous time had taken service and discontinued later, 524 buildings never previously served, and 185 new buildings. Increased construction is evident from the fact that only 150 new buildings were connected in 1947 and 102 in 1946. Most new customers were in the retail store and restaurant group. However, the group made up of hotels, apartments, clubs, hospi-

tals and residences led in revenue, with the office and bank group second.

Thirteen companies lost 52 customers in 1948 with a revenue of $137,989. By way of comparison, 11 companies lost 68 customers in 1947 with a revenue of $203,237.

Twenty-four of 52 reporting utilities said they had insufficient plant capacity and eight insufficient distribution facilities. Twelve companies plan to add plant capacity totaling 1,540,000 lb per hr. Ten, although lacking capacity, do not plan to make additions. Twenty-three will add to their distribution systems. Therefore, it appears that soon most heating companies, for the first time since the war, again will have enough capacity.

Harry A. Weitzman, Rochester [N. Y.] Gas and Electric Corp., chairman of the rates and regulations committee, reported on steam rate revisions and abandonments of district heating service.

Steam Rates Being Increased

He said that, as the result of the inflationary nature of the times, 23 utilities in 27 cities had increased 36 steam rates. Seventeen of these revisions were simple increases on the base rate, producing reported increases of revenue varying from 9 percent to 15 percent. Thirteen revisions also added or raised fuel adjustments, producing reported increases in revenue varying from 5 to 75 percent. While the remaining six revisions lowered or eliminated fuel adjustments, in combination with base rate adjustments, net reported increases in revenue were produced varying from 6 to 52 percent.

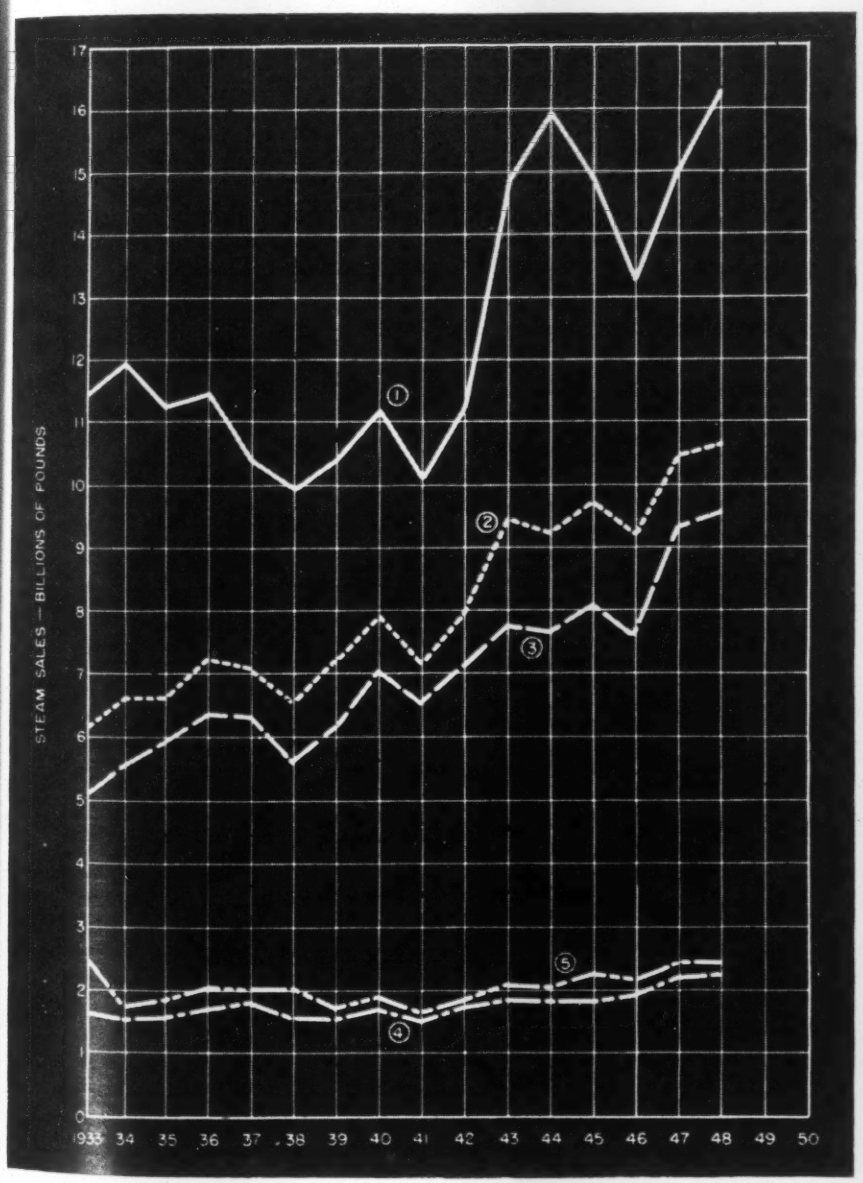
Ninety-four rates in use by 44 utilities in 59 cities were unchanged. However, many of these were revised upward in 1947.

The committee emphasized the worth and effectiveness of fuel clauses. It reported that only 12 percent of the utilities and 18 percent of the rates now lack fuel provisions.

The report on the case histories of district heating system abandonments showed that over the past decade 11 small town district heating systems, 36 years old on an average and having from 48 to 233 customers, had been taken out of service. Chairman Weitzman reported the losses were the result of the age, nature, and location of the systems, inadequate rates, increased operating costs, and the necessity of making prohibitively large expenditures for replacements and to take care of increased loads.

It is anticipated that the new third edition of the NDHA's district heating handbook, which will have approximately 600 pages of information on all phases of district heating and equipment and on which the association has been at work for several years, will be off the press late this coming fall. Chairman J. Earl Seiter of the educational committee reported satisfactory editorial progress.

Steam sales as reported by members of the NDHA. The figures are divided into five groups depending upon the volume of annual sales



Loucks Installed as President

During the closing session of the meeting, the following were inducted into office: David W. Loucks, Allegheny County Steam Heating Co., Pittsburgh, Pa., president; G. H. Tuttle, The Detroit Edison Co., first vice-president; Alfred T. Veness, Rochester [N. Y.] Gas and Electric Corp., second vice-president; and Percy A. Hyde, Ohio Edison Co., Akron, third vice-president, all for the coming year.

Harold W. Coombs, Badger Mfg. Co., Cambridge, Mass., Robert D. Martin, New York Steam Corp., and F. Lee Rapson, Consolidated Gas Electric Light and Power Co. of Baltimore, were elected to the executive board for terms of two years.

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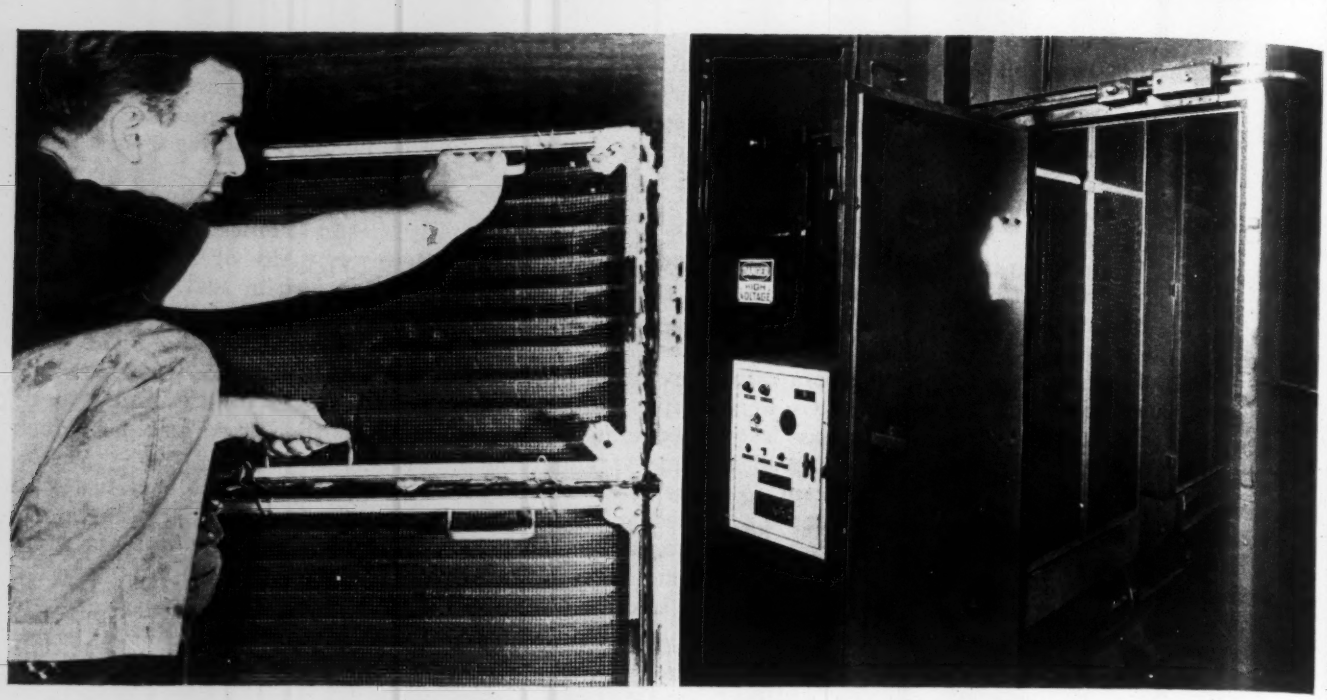


Left—A maintenance man changing a paper filled filter at Eli Lilly and Co. Right—A traveling plate type of electrostatic filter cleaning the air supplied to a building

Proper Air Filter Maintenance Pays Industry in Good Results

B. G. Evans, assistant manager of maintenance departments, Eli Lilly and Co., Indianapolis, believes that an air filter installation "is only as good as it is maintained." He describes here the various types of filters used at the Lilly plant for different services, and their operation and maintenance. One of the principal ventilation problems in the pharmaceutical industry is filtering impurities from the air

ONE OF THE great problems in connection with ventilation in the pharmaceutical industry — as in many industries—is filtering impurities from the air. There are many processes in making medicine that require large quantities of outdoor air but which cannot tolerate the large concentration of dirt and dust which is found in the atmosphere in industrial cities. The air supplied to vaccine filling rooms is one example where filtering of high efficiency is required. The supply air to rooms where animals are being used for testing the potency of vitamins is another application where filters are required.

Through the years, engineers and manufacturers have struggled with this problem of air filtration and have invented many ingenious devices for catching dirt and dust particles. We are concerned in this article with the design features of filters as they affect maintenance. The design engineer is concerned primarily with the efficiency of the removal of dust and dirt particles from the air stream, and the maintenance engineer is concerned mainly with keeping the filters reasonably clean so that they can continue to operate at design efficiency. If filters are not cleaned or replaced when they become dirty, they will impede air flow and sometimes allow dirt particles to be blown through because of the high velocity in sections of the filter.

Since some types of filters work better in a given application than do others, we have found it necessary to use a number of different filters, and the maintenance of them varies with each application.

Where we filter the air supplied to a building, we use a wire mesh cleanable filter. The dirt in the air in the heart of Indianapolis is predominantly of a greasy consistency and has a tendency to clog some

types of filters. The wire mesh cleanable filter does not have as high a cleaning efficiency as some other types, but it does remove enough impurities to make the air tolerable when supplied to ventilate a building. It has large dust holding capacity.

Cleaning the Wire Mesh Filter

This type of filter may be cleaned by spraying with steam and a cleaning solution such as kerosene, or it may be dipped manually or automatically in a cleaning solution and set up to dry. It can then be dipped in an adhesive oil or sprayed with oil, but the dipping method is preferred by us because it is more thorough and soaks all of the wires in the filter instead of just the outer ones.

When we first adopted the cleanable filter, we considered the cost of setting up a filter cleaning department in our plant, but this involved the installation of a spray booth with an exhaust system, spray guns, dipping tanks, and other accessories. It also involved procurement and training of a filter cleaning crew. This was at a time when labor costs were extremely high, and when qualified employees were hard to find. We decided in favor of the service of a local filter cleaning concern, but now that the manpower situation has eased, we may again consider setting up our own filter cleaning facilities.

Paper Filters, Electrical Precipitation Used

In those applications requiring a high purity of supply air, yet not justifying the installation of an electrostatic filter, we use a filter consisting of multiple layers of paper lapped over a serrated frame. This filter, when sprayed with oil, gives us a high efficiency of dust collection but does not have much dust holding capacity; consequently, the paper must be changed frequently.

In those applications with rigid air filtration requirements, we use an electrical precipitation filter of either the stationary cell or the traveling plate type.

We also have some applications where we use a filter that utilizes the electrical precipitation principle together with paper media. This filter consists of ionizing wires and a charged serrated wire frame backing up the paper. This paper backing catches the dirt in case the filter should short circuit.

We have had good luck with stationary cell type filters. These are cleaned by directing a very hot jet of water against the ionizing wires and plates. This water must be at approximately 200-210 F for best results; otherwise, a nontoxic, nonodorous solvent is recommended. We have found that it takes about 1 hr to clean a filter sized to handle approximately 10,000 cfm, allowing for set-up time. It would be our recommendation that back up filters of a multiple layer paper be used in conjunction with this type of filter so that the fans can be used to dry the plates of the cells without the danger of blowing a large amount of dust into the ducts and rooms served by the system. If a large amount of dirt does get into the ducts, they must be cleaned to prevent the dirt from entering the ventilated spaces.

Traveling Plate Electrostatic Filters

We have installed a number of traveling plate type electrostatic filters where our dust loads have been high and yet where maximum cleaning efficiency was desired. This filter has ionizing wires which charge the particles so that they will be attracted by plates downstream from the wires which are alternately grounded and charged with opposite polarity from that of the ionizing wires.

These plates are built into a continuous screen which rotates and dips into an oil bath which removes the accumulated dirt particles from the plates. The cleaned plates then move back up into the air stream where electrically charged particles deposit on their oily surfaces.

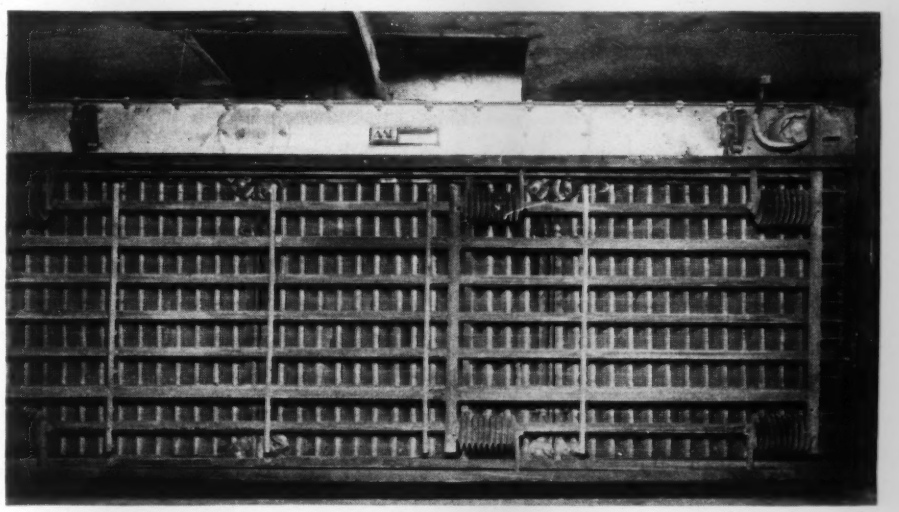
These plates move past stationary plates, and since the stationary plates are charged to attract oppositely charged dust particles, they soon build up a layer of dirt which must be cleaned off. This is accomplished by means of a traveling wiper which rotates with the moving plates and removes the accumulated dirt from the stationary plates and deposits it into the oil bath at the bottom of the filter.

We experienced some difficulty with this type of filter in one application where the dust load was very high because the air was brought in above a railroad switching spur adjacent to a number of railroad tracks. The dirt built up on the plates faster than it could be removed, and eventually became so thick that an electric arc occurred between the plates. This caused a fire which warped and damaged most of the plates. We finally overcame the fire difficulty by using a fire resistant oil.

It is very important to keep the oil level in the sump at the recommended height so that the dirt will be washed from the plates and the wiper and not build up excessively. It is also necessary periodically to remove the dirt sludge from the sump of this filter; otherwise, the oil bath will not keep the plates and wiper as clean as is necessary.

We are experimenting with an oil purifier installation whereby we cir-

An electrostatic filter with a paper filler used as a final filter for removing dust from air supplied to a capsule filling room



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culate the oil in the filter sump through an earth filter to remove the dirt and sludge. We have not had time to observe how efficiently it will clean this oil or how economical its operation will be, but are making a study of these points.

Oil Carryover Troubles Corrected

We have also had some trouble from oil carryover in our traveling plate electrostatic type filters. This oil has been blown into our ducts, and in some cases it has been blown out into some of our rooms in a thick cloud of smoke when the heating coils were turned on. This carryover oil was also undesirable from another standpoint in that it tended to insulate the heating coils and to reduce their heat transfer.

The filter manufacturer thought that this carryover on some of the filters was probably caused by the fact that they were using two or more thicknesses of thinner gage steel in place of the single sheet of heavy gage metal which had been used in the past. (They were forced to do this since there was a shortage of the desired gage of steel plates.)

It was thought that the oil picked up in the sump was held by capillary attraction by these plates until it had moved over the top of the filter and was dumped into the air stream. The manufacturer remedied our problem by the installation of a wire screen directly behind this filter and avoided this trouble in subsequent filters by using only the heavier gage sheets for the plates.

The traveling plate type electrostatic filter plays an important part in filtering at Eli Lilly. It should be cleaned at a frequency of between once a week and once a month in the average city installation depending upon the concentration of dust in the air handled by the filter. Cleaning consists of wiping down the ionizing wires, wiping grease and dirt from the edges of the plates and the cross bars, dipping out the sludge which has accumulated in the sump, and refilling the sump with oil to the recommended oil level.

We service the electrified paper mat type filters by wiping off the ionizing wires, lifting out the filter, and changing the paper media.

In those applications requiring a paper mat type filter which must be fireproof, a paper has been developed which has fire resistant qualities.

Maintenance of Prime Importance

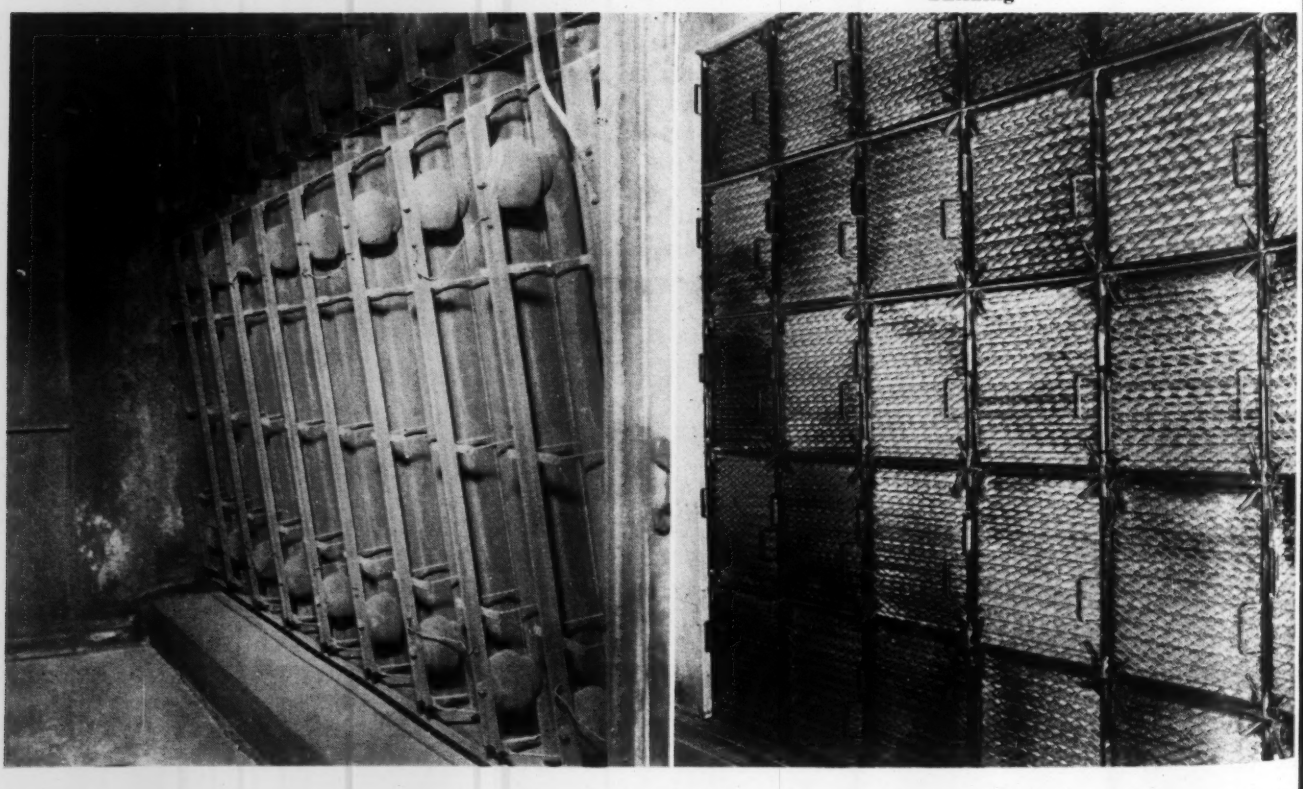
Keeping filters maintained in an industrial plant is of prime importance because if they are not changed and cleaned periodically, many undesirable conditions—such as dark spots on ceilings, restricted air flow in the system causing improper ventilation or heating or cooling, and specks of dirt in the air supply to the rooms—may be expected.

In one case, it was discovered that not enough air was being supplied to the rooms in a large building. The maintenance men claimed they had been working in accordance with a filter cleaning schedule. In this case, the filters used were of the paper mat type and subject to clogging with dust particles. These filters were handling outside air which consisted of approximately 75 percent greasy dust particles and 25 percent dry dust particles.

In an effort to increase the amount of air supplied to this building, a larger motor was installed and the fan was speeded up. This resulted in such a small increase of air quantity that we immediately became suspicious of the cleanliness of our filters. We had new paper placed in the filters and then started the system. This time, the fan handled so much air that it quickly overloaded the motor.

Modern management must recognize the necessity of keeping air filters clean, because a filter installation is only as good as it is maintained.

***Left*—A bank of electrostatic cell type filters for cleaning the air supply to animal testing rooms. *Right*—Cleanable filters for the air supplied to a building**



Air view of the Decatur, Ill., plant of the A. E. Staley Mfg. Co. Lower center is the company's imposing administration building which is an impressive landmark, particularly at night when it is lighted with an ever changing pattern of color. The plant proper extends back to the railroad yards in the background. Not in the picture are another two block long area of buildings at the left and a stretch of plant grounds a half mile farther to the right. Far to the right in the area not pictured are a bank of receiving elevators, storage for more than 6,000,000 bushels of grain, soybean grinding and preparation buildings, a soy oil extraction plant, and the site for another

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Light Wall Stainless Tubing *Used in Wet Corn Processing*

STAINLESS STEEL tubing is being used in the manufacturing operations of A. E. Staley Mfg. Co., Decatur, Ill., processors of corn and soybeans. The light wall stainless is specified in new projects where piping will be called upon to carry liquids of corrosive nature, and for replacement of existing piping systems whenever replacement is necessary.

Both the new installations and the replacement work are part of an extensive program of modernization going on throughout the plant. As in all wet milling plants, much of the process involves transfer of ground corn in liquids along the various steps of the processes.

Tubing used varies from 2 to 12 in. OD and is 14 ga, except for the 2 and 3 in. sizes, which are 16 ga. Light wall (12 ga) stainless fittings are used, the heavier gage being chosen to make up for any increased wear at the bends. Joints are made by van stone flanges with a specially designed carbon steel backup flange, or in some cases by welded joints.

Requirements of the job call for materials which are resistant to the corrosive action of sulfur dioxide and organic acids in process waters; resistant to abrasive action of grain solids; smooth, with easily cleaned surfaces, to meet sanitation requirements; and easy to dismantle when required for quick repairs or cleaning.

Stainless steel No. 316 with a maximum carbon content of 0.05 percent is specified to meet the required corrosion resistance. The additional cost over other steels has been found worthwhile in eliminating occasional failures by pitting, especially near welds.

A new van stoning machine is used. In two simple operations, re-

WILLIAM B. BISHOP, technical superintendent, A. E. Staley Mfg. Co., Decatur, Ill., describes the use of light wall stainless steel tubing for new work and replacements, part of an extensive program of modernization at this corn and soybean processing plant. A new van stoning machine is utilized, which rolls and flattens a flange on tubing previously cut to the desired length

Flanging is an easy job on the special van stone flanging machine. The heavy gage stainless steel tubing is cold rolled into a lip for the flange connection. The roller dies are easily changed for different operations and different diameters in the flanging operation. The roller die tool sitting on top of the flanging machine at the right is used for the initial operation, which rolls the pipe edge out to a 45 deg angle

quiring less than a minute, the machine rolls and flattens a flange of the desired dimension on the tubing which has been previously cut to the desired length. The machine is portable and can be transported to the job when necessary.

The joint is assembled with a 3/16 in. rubber gasket between flanges, backed up with a special carbon steel split flange. To make possible connections between stainless tubing and existing pipe, the bolt spacings match standard 125 lb flanges. A lip on the circumference of the flange closes the opening between, which eliminates a pocket where dirt might collect. The carbon steel flanges are coated with vinyl resin paint to resist corrosion.

Although most of the applications in this plant are at low pressure, these joints have been tested up to several hundred pounds. Repeated tests have shown that the cold working during the van stoning operation does not affect corrosion resistance.

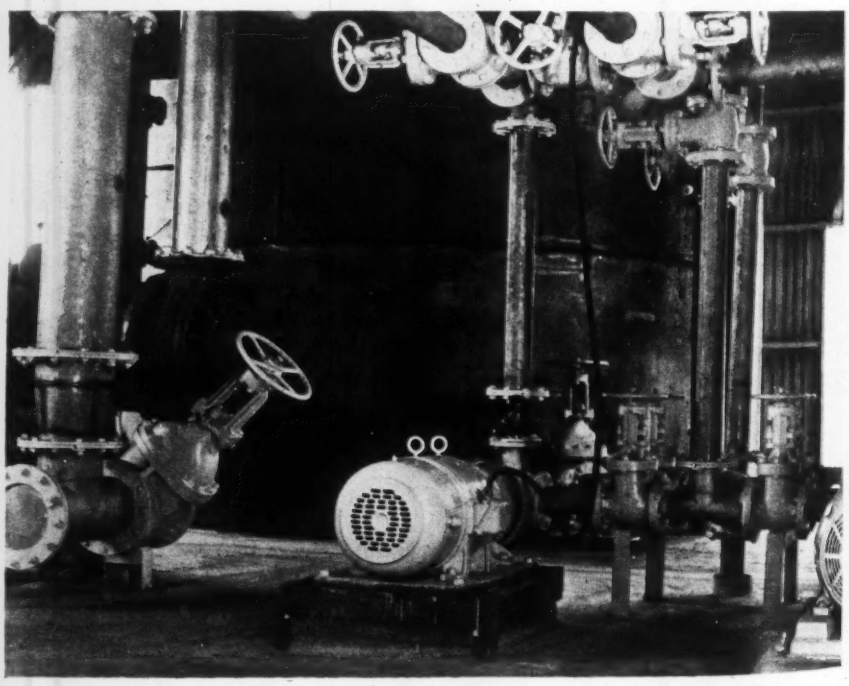
Since this modernization program called for gradual replacement of existing lines, it was desirable that fittings correspond to the dimensions of standard 125 lb flanged fittings. This necessitated development of a new line of van stone light wall fittings of standard dimensions.

Several thousand feet of stainless tubing have been installed and put in use during the past six months. Principal applications are in lines carrying starch slurries to and from vibrating screens, corn solubles to evaporators, and starch and gluten to and from storage tanks.

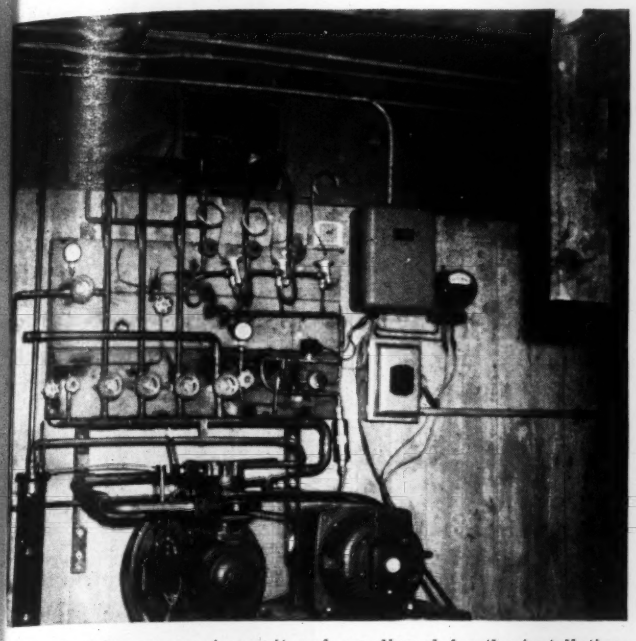
H. K. Ferguson Co. is the engineer and contractor.

BUILDING RESEARCH BOARD ORGANIZES

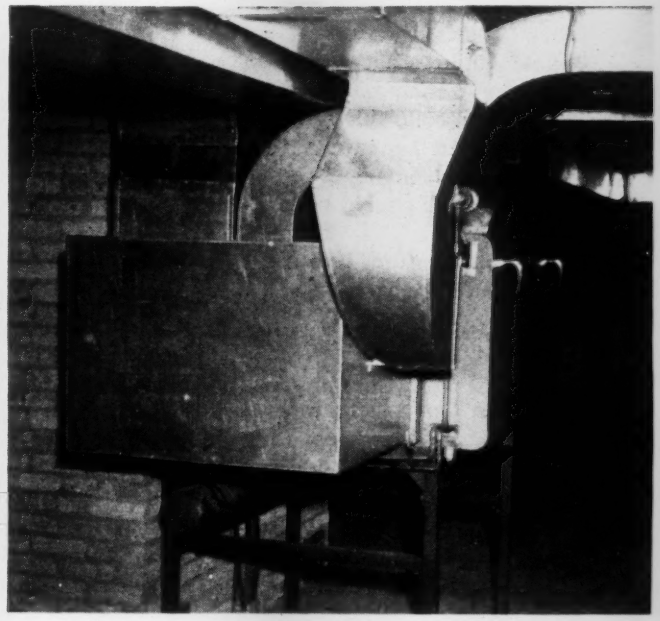
The National Research Council has announced that its new building research advisory board has organized itself into a nonpartisan, fact finding group for government, private industry, and educational institutions, to help mobilize American research talent on a public service basis to produce facts aimed at providing more and better building construction, including housing for more people at lower cost.



Miles of different sizes of stainless steel tubing are to be found throughout the corn and soybean processing plant of A. E. Staley Mfg. Co. All the piping shown in this corner of the plant is stainless tubing which replaced other types of piping in the past year. Plans call for a steady change until all piping carrying corrosive solutions is stainless



Left—The 5 hp compressing unit and panelboard for the installation. During January, the machine operated 0.308 hr per degree day. Right—



This view of the air conditioner shows the return air ducts in the foreground

Operating Data on Heat Pump Shows Application of Method

G. D. WETHERBEE, refrigerating engineer, Chicago, has obtained considerable operating and performance data on a test installation of a 5 hp heat pump job, the basic design of which was conceived and calculated by him. As a result, he feels certain that this method of heating will become accepted for regions with a normal heating season of around 6300 degree days. In this and future articles he presents the data, together with information and comments on the details of the design and installation

On December 8, 1948, a 5 hp refrigerating unit was placed in operation in Mt. Prospect, Ill., about 20 miles northwest of Chicago. This heat pump installation is the sole source of heat for the one story, six room building, which is occupied by Mr. and Mrs. Roy E. Hammond, except for a fireplace for decorative purposes and a 1500 watt bathroom heater. The plan area is 1433 sq ft outside of the foundation. The ceiling height is 8 ft. There is a full basement 7 ft high. The heating system consists of a 5 hp compressing unit, a conventional duct system for air distribution, and a combination of earth-buried and atmospheric coils as a heat source.

Although the installation has given perfect satisfaction, it cannot be regarded as commercially perfected. It is definitely a test installation and will continue to be until a winter comparable to 1935-1936 has been experienced. However, the results have been so far beyond expectations that it seems certain to the author that within a period of years, the heat pump will become an accepted method of heating in regions with a normal heating season of 6300 degree days.

This statement should probably be qualified by assuming that the purchaser is willing to make an additional investment for summer cooling and the other advantages of the method. Just how much this will be is uncertain, but it appears that the first cost of a heat pump job can never be competitive with fuel burning installations for heating only.

In designing this system, we did not do everything right by any means. Before next winter, we will make a number of improvements. Thus, in these articles, no claims of any kind are made. The objective is simply to tell what was done and what happened; there seems to be need for data on the results with and performance of actual heat pump installations.

The results observed this winter do not *finally* prove anything for a number of reasons. For example:

1) The winter was unusually warm. The mean temperature in January was 28.4 F, whereas normal is 22.3 F and 11.9 F was recorded in 1912. There were only two days with a mean temperature below 10 F; January 29 and 30 with mean temperatures of 2 F and 6 F respectively.

2) The basement has not been adequately heated; it has been at 50 to 60 F.

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3) The ceiling has not been completely insulated.

4) Double windows have not been installed.

5) The earth coils have never been fully flooded because of expansion valve problems.

6) The condenser should be larger.

7) The liquid-suction line heat exchanger should be larger.

Hours of Operation and Electricity Use

Chicago Weather Bureau data have been used, although the winter temperatures in Mt. Prospect are somewhat colder. For instance, when the official temperature was –4 F, the temperature in Mt. Prospect was observed as –9 F.

With the building incomplete when the heating system was placed in operation, it was meaningless to keep exact records of operation. The plastering was in process, the doors were temporary, and the painters and carpenters came later. Hence, the records start January 1, 1949.

The daily records of hours of operation and degree days, although showing the usual experimental discrepancies, indicate the general pattern to be consistent; on the cold days, the machine ran less per degree day than on warm days.

During January, the machine operated 0.308 hr per degree day, and during February, 0.283 hr per degree day. This small reduction may have been due to better performance of the earth coils after installing new expansion valves on February 12.

Kwhr meter readings

		Difference
Main service meter readings:		
Dec. 31, 1948	1485	....
Jan. 31, 1949	3515	2030
Feb. 28, 1949	5210	1695
Mar. 19, 1949	6260	1050
Compressing unit meter readings:		
Jan. 31, 1949	0086	1640 (estimated)
Feb. 28, 1949	1466	1380
Mar. 19, 1949	2300	834

Watthour meter readings for the compressor motor were first recorded on January 31. They show that 1380 kwhr was used during the 28 days of February. This figures out as 4.7 kwhr per hr of motor operation and 1.33 kwhr per degree day. The cost of electricity is 2c per kwhr. For the same period, a total of 1695 kwhr was used for all purposes, including the air conditioner blower and the earth recharging pump. Thus, 81 percent of all the electricity consumed in the structure was used by the motor which drives the compressor.

From January 1 to March 18, inclusive, 3854 kwhr was used. For this period, the degree day total was 2788; thus 1.385 kwhr per degree day was used.

Load factor is a ratio employed to express the hours use of the maximum demand; it is kwhr divided by the product of the maximum kw registered in any period on a demand meter and elapsed hours. Demand meters usually record the highest average use of electricity in a half-hour period. Where the load is constant and operates for half an hour or more at one time, the load factor expressed percent of running time.

The load factor for this installation for February was 43½ percent. The estimated load factor for January was 47½ percent.

Murphy & Miller, Inc., Chicago air conditioning and refrigeration contractors, furnished most of the equipment as a contribution to the heat pump industry. Daily readings were taken by Roy E. Hammond who was also responsible for most of the construction details of the installation. The cooperation of M. F. May, J. A. Schenk, and R. M. Wineman is gratefully acknowledged.

Future articles in these pages will present further details of the design and installation of this system, together with a considerable amount of operating and performance data.

Hours operation of compressing unit

Jan.	Mean Temp.	Deg Days	Hours	Feb.	Mean Temp.	Deg Days	Hours
s 1	22	43	11.08	1	18	47	12.42
s 2	30	35	10.33	2	14	51	13.33
3	36	29	10.67	3	27	38	11.92
4	40	25	10.08	4	18	47	10.67
5	32	33	10.17	s 5	14	51	12.58
6	31	34	10.67	s 6	22	43	16.33
7	44	21	9.08	7	18	47	10.17
s 8	44	21	8.75	8	30	35	11.50
s 9	38	27	8.50	9	21	44	9.83
10	34	31	8.92	10	22	43	12.33
11	30	35	11.50	11	28	37	9.50
12	28	37	11.75	s12	40	25	8.75
13	28	37	9.83	s13	32	33	10.50
14	32	33	10.17	14	25	40	12.50
s15	46	19	7.42	15	26	39	11.92
s16	40	25	8.75	16	26	39	9.58
17	22	43	10.92	17	28	37	8.50
18	26	39	11.83	18	46	19	7.00
19	16	49	11.67	s19	38	27	8.50
20	16	49	16.08	s20	32	33	8.67
21	24	41	11.50	21	36	29	9.17
s22	19	46	12.50	22	34	31	10.42
s23	34	31	11.83	23	35	30	8.33
24	32	33	10.33	24	38	27	7.50
25	28	37	11.00	25	29	36	12.00
26	30	35	10.75	s26	35	30	8.67
27	33	32	11.58	s27	30	35	10.50
28	20	45	12.00	28	19	46	10.67
s29	2	63	17.92				
s30	6	59	15.58				
31	18	47	16.33				
Mean	28.4				27.6		
Normal	22.3	1262			24.9	1098	
Total		1134	349.9			1039	293.76

Clock read at irregular hours each night.
Weather data from U. S. Weather Bureau, Chicago.
"s" means Saturday or Sunday.

VENTILATION NEEDED WHEN USING SOLVENTS

A NUMBER OF comments have been published in HPAC's "Open for Discussion" pages on the need of care when carbon tetrachloride is used to clean fans and ducts. May we add our word, since it seems to us that HPAC's readers might think that precautions are necessary only with carbon tetrachloride.

The fact is that no organic solvent can be used without precautions. Some present a toxicity hazard, some a flammability hazard primarily (none are completely nontoxic), and some present both.

Regardless of the solvent employed, therefore, ventilation should be provided. If this is not possible, the individual doing the work should wear a suitable respirator and protective gloves. If the solvent is flammable, additional precautions will be necessary to prevent fire.—BRAHNA C. HUTCHINS, president, Safety Research Institute, Inc., New York City.

Balanced and Orificed System Saves Building Heating Steam

CHARLES J. LEHN, engineer for the Field Estate and consulting engineer, describes the method of balancing and controlling the heating steam for the 45 story Field building in Chicago's "Loop." The method has resulted in a 15 to 20 percent reduction in the steam required for heating the building. Every 5 deg rise or drop in the outside temperature requires a decrease or increase in steam supplied of approximately 2000 lb per hr

WITH MORE THAN 40 years of experience in supervising operation and maintenance of the mechanical equipment required for office, hotel, and loft buildings, it might prove advantageous to others for me to pass on some observations concerning changes and improvements made in such services. This article deals with heat control.

When the Field building, Chicago, was constructed, the heating system was a two pipe vacuum installation, with the direct control or thermostatic valves. This valve controlled the steam supply to the radiator by means of a bulb which contained a suitable liquid, closing and opening the steam valve to the radiator in accordance with its room temperature setting. The company manufacturing the direct control valves had discontinued them, and as a result, replacement valves or repair parts could not be obtained—so that other means of heat control had to be substituted.

There are approximately 3760 radiators in the building, each of which was originally equipped with the direct control or thermostatic valve. To change all of this equipment to any other thermostatic control was an operation of major proportion.

I decided to use a control method that would maintain constant heat in relation to outside temperature requirements.

Orificing the space to be heated in relation to the heat loss of that space, and controlling the heat supply continuously to maintain predetermined temperatures in that space, with gravity returns properly vented, results in satisfactory temperatures in all spaces.

Orificing the Heated Space

Accordingly, I made the necessary calculations for orificing all of the heated spaces in the building. It was interesting to note the influence that occupancy had on the calculations. For instance, I found that the heat build-up by lighting and people in the Field building is equal to 200 boiler horsepower and an allowance had to be made to offset this build-up; otherwise, the temperature throughout the building would increase considerably in the first 3 hr of occupancy. I have also found that, in many cases, after spaces have become occupied, changes must be made in the orifice opening to offset the heat build-up in one space over another, according to the occupancy of that space.

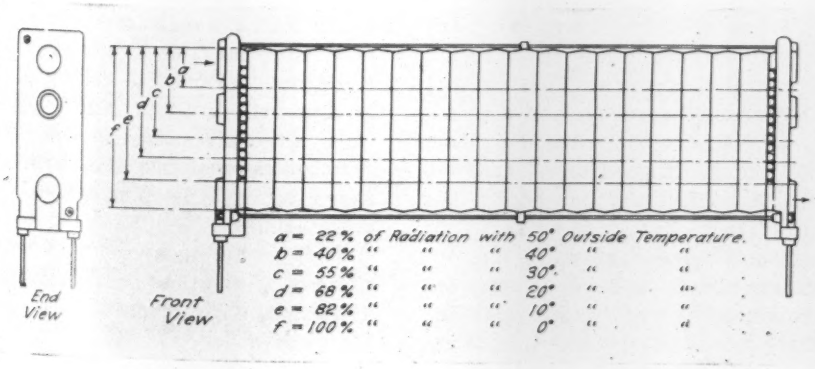
Based on government weather statistics the average variable temperature for each 5 deg mean temperature is as shown on the accompanying chart. This chart is followed in making up or deducting the steam for heating requirements.

It so happens that a 5 deg rise or drop in the outside temperature requires a decrease or increase in steam supply of approximately 2000 lb per hr. This 2000 lb of steam has to be equally distributed to 3760 radiators or 137,000 sq ft of radiation. It was found that we could meet this variable steam supply requirement to the heating mains and distribute this amount of steam per hour equally to each radiator. Following this, all heating mains and riser areas had to be checked and orificed for equal distribution to the space or radiator.

A correction was made as to temperature and pressures throughout the system on all risers at various locations. Once this was accomplished, it was an easy matter to proportion the exact amount of heat for each space through the installed radiation.

The orifices were installed and the system was put into operation. Steam is retained in the radiators continuously as required to main-

The author installs on some jobs a "pilot radiator" in the boiler room marked off in this manner to show the portions of it that should be heated at various outside temperatures. The amount of radiation required for heating with the outside temperatures as noted is shown in percent of total radiation. This particular type heats from top to bottom. Similar percentage markings from left to right would of course be used if the radiator heated up in that way



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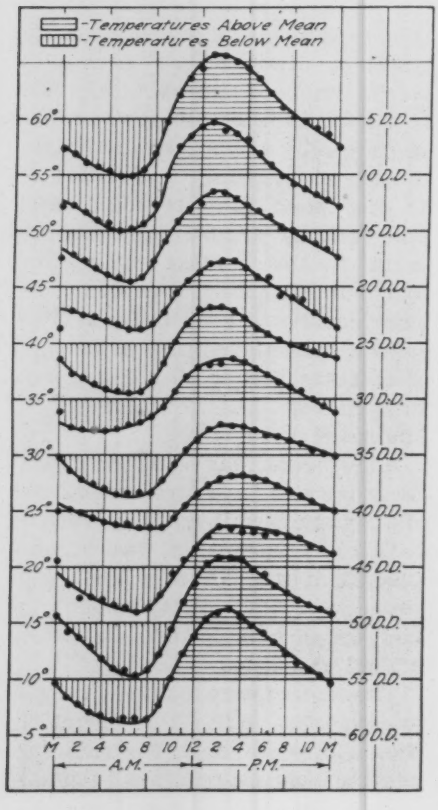
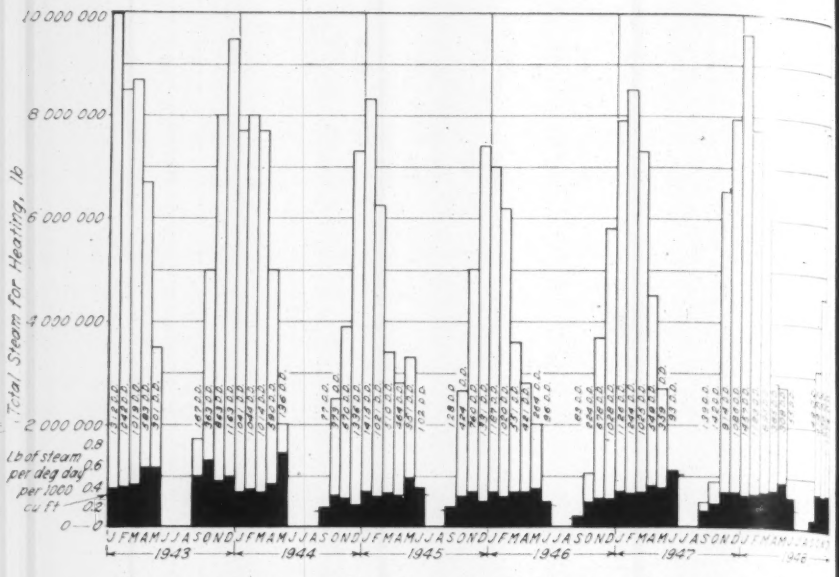
tain constant temperature and it has been found, by actual record, that an increase or decrease of 8 to 10 F in the outside temperature is not effective on the inside for from 3 to 5 hr; in other words, if there is an increase or decrease in the outside temperature of from 5 to 10 F at 2:00 p.m., no change is necessary throughout the remainder of the business day insofar as increasing or decreasing the heat supply is concerned.

Less Steam per D.D. at Lower Degree Days

Since this installation was made and put in operation, it has been observed that less heat or steam is required per degree day for 10 and 15 degree day days than for 40 or 50 degree day days. This observation was startling at first, but it was found that the percent of heat pick-up in the spaces by the people and the lighting is much higher at 10 degree days than at 40 degree days. This condition is very noticeable, so that it is necessary to reduce the heat supply per degree day at 10, 15, and 20 degree days to offset this heat gain as against 40, 50, or 60 degree days.

This chart of average hourly temperatures for each 5 deg mean temperature is used in figuring heating steam requirements. At the Field building, a 5 deg rise or drop in the outside temperature requires a decrease or increase in the steam supply of about 2000 lb per hr





Steam requirements have been reduced 15 to 20 percent

No Saving in Night Shutoff

We have found that there is no saving in shutting off steam in the building at night over leaving the steam on 24 hr per day at 40 F outside temperature or less. I do not mean that the same degree of heat at night is good practice or is economical, but assuming that an hourly load of 600 hp is required through the day, then this load can be decreased to 400 or 200 hp at night. This reduction can be accomplished in 10 sec, thus reducing the heat supply in the same percentage to every radiator and maintaining equal distribution in every unit throughout the system.

[Where steam is purchased, and boiler efficiency is not a consideration of the user, there is a definite saving by night shutoff.]

Steam Consumption Reduced

Steam enters the radiators at its steam temperature according to a pressure of 2, 4, 6, or 8 oz, or at approximately 214 to 216 deg. The condensation leaving the radiator at 35 deg outside temperature does not exceed 85 deg.

The steam requirements for heating the building have been reduced by this application of orificing approximately 15 to 20 percent.

FLEISHER SEES PANEL COOLING PROMISING

Although he said that radiant panel heating systems are "grossly over-rated," inasmuch as "a well-insulated enclosure with any kind of radiation that will bring the surfaces of the room to proper temperature should act very similarly to any panel heating system" Walter L. Fleisher, consulting engineer, a past president of the American Society of Heating and Ventilating Engineers, and a member of HPAC's board of consulting and contributing editors, remarked that panel heating has shown the way toward the possibility of "a very marked reduction in the requirements of cooling by the instrumentality of panel cooling where comparatively warm water, or water possible to obtain in the summertime, circulating above the ceilings would remove a great deal of the heat given off by the electrical fixtures—often one of the main sources of sensible heat gain in such places as department stores or rooms of this character—or where a roof load is a main source of heat. With the heat from lighting fixtures radiating toward the ceiling, coils in the ceiling could readily carry off a large proportion of this heat, which otherwise has to be compensated for by low temperature refrigeration."

Mr. Fleisher spoke before a group of adult students of heating and air conditioning problems at New York University.

Modern Thinking Applied to

DUCT DESIGN

KIRBY WALKER draws upon his experience both in the heating and ventilating field and in wartime research and engineering to discuss duct design. A licensed professional engineer, he was engaged on heat transfer and combustion projects for two large aircraft companies during the war. He has had a wide experience in the heating and ventilating industry, and has supervised manufacturers' laboratory and development personnel. This is the third of a series. In the March issue, straight ducts were discussed, and in April some amplifications and corrections appeared. In May, the subject of elbows was covered. This month, plotting and predicting pressures is discussed. Future articles will take up convergence, reduction in area; enlargements; tees and duct branches; duct sizing methods and comments; a summary of points brought out in the series; symbols and formulas; and references and source material, with the author's comments on their contents

IT IS IMPORTANT to realize that pressure loss is to be deducted from total pressure. The practice of talking about "losing the velocity head," "regaining the static," etc., is confusing and complicates problems. For a given proportionate shape of channel at a given Reynolds number, f' has a definite value between two given points. Use it to find the drop in total pressure.

A second help in understanding pressures is an ability to use trial computation. In designing duct work, this means assuming certain flows, certain types, and certain sizes of obstructions, and then estimating the results from the assumptions to see if the result justifies the assumptions. This is a most practical procedure for most flow problems.

A third help is the understanding of a method for plotting a pressure gradient. This should be plotted through the entire duct circuit and then outside and back to the inlet. Each point in the duct work is given a number to identify its place on the gradient chart. I am not advocating the plotting of every duct system, but am saying that plotting some particular case will solve a particular problem and clarify the issues involved. From the plot, a pressure at a given point can be determined.

Predicting Pressure at a Given Point

Let the vertical dimension on a chart be pressure, say inches of water column. The lines move to the right—as the fluid flows and as various points in the duct circuit are numbered. The top line is the total pressure line, the static pressure line is one velocity head lower. The altitude pressure line is one static pressure below the static pressure line. The reference line is a distance below that equal to the product of the altitude above the reference line times the density of the fluid in the pipe.

Thus, there are four lines separated by three dimensions. From the top the dimensions are velocity pressure, static pressure, altitude pressure. The static pressure is absolute. The bottom line is straight, horizontal, and may be any zero altitude reference located below the lowest point of the circuit. This briefly outlines gradients that will plot any condition and applies to condensive and to convective processes like chimneys where the fluid changes density.

By abridging certain of the three pressure dimensions listed above, a simpler method is evolved for plotting most problems in duct work. It does not apply where there is any change in density, or where there is any condensive, evaporative, convective or other "floating" effect modifying the flow of the fluid. This method has three lines separated by two dimensions. Beginning from the top, they are the velocity pressure and the static pressure (the static pressure may be inches of water column above the ambient atmospheric pressure), and the bottom line is horizontal at atmospheric pressure.

In plotting there are many obvious facts that help in piecing together the gradients to make the chart complete. Sometimes you plot from both ends to meet in the middle, or follow other feats of deduction and trial computation. Among the simple helps for plotting are:

1) A fan raises the top line.

SYMBOLS

A = (area) = (square feet); usually duct cross-section

cfm = (actual cfm)

D = (equivalent diameter) = (feet) = $\frac{1}{3}\frac{\text{(sectional area, square inches)}}{\text{(perimeter, inches)}}$

f' = (friction coefficient, shock losses) = h / q

fpm = (actual average feet per minute velocity)

h = (loss of total pressure) = (inches 32 F water column)

$h = q f'$; shock losses, obstructions

q = (one velocity head of the average velocity) = (inches, 32 F water column)

$R.N.$ = Reynolds number

w = (density) = (lb) / (cu ft); any fluid

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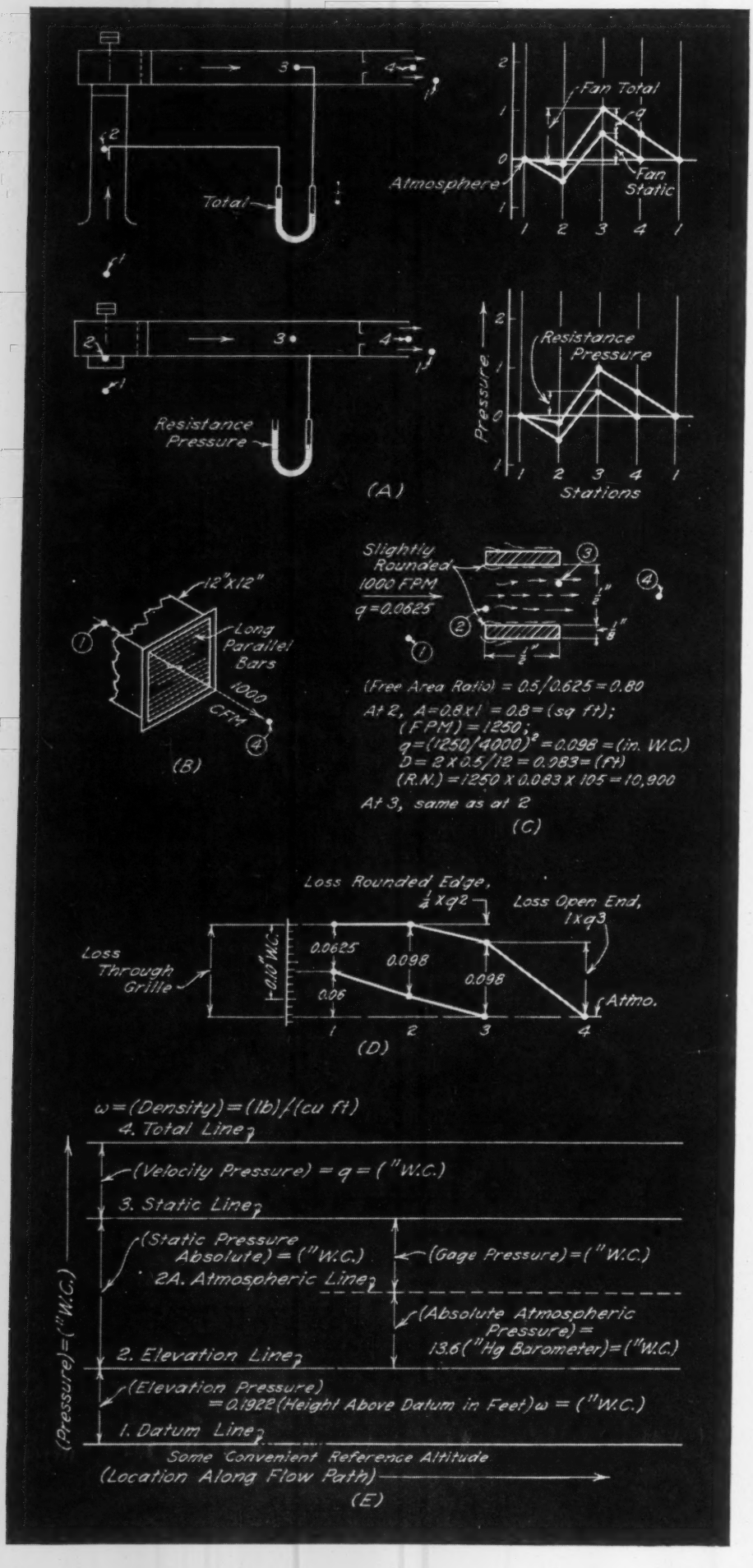


2) Friction, h, lowers th top lin

3) The static line is on velocity head below the top line.

4) Where open static exists, th static inside an opening is the same as the static outside the opening

Illustrating Use of Pressure Plotting

In order to illustrate the use of pressure plotting, refer to Fig. 10A which shows fan catalog pressures. A study of this will explain why there is confusion in the use of pressures from fan tables and it clearly illustrates their proper use.

For further illustration, Figs. 10B, C, and D are presented to illustrate a reasonable pressure analysis at a supply grille. Of course, the data on a given type of grille opening construction should be plotted for *R.N.* in the grille openings, the *q* and the *R.N.* values being taken in the space between the bars, this being the smallest practical measurable space and the place where the highest velocities would be found.

The data shown are rough and intended only for preliminary estimates. We are given a supply grille as in Fig. 10B with flows shown, and a detail of the bar spacing in Fig. 10C. Because the upstream edge of the bar is not sharp and because the bar approaches being a plate edgewise in a free stream, it is doubtful that there would be much of a vena contracta to put this obstruction in the orifice class. We therefore let $f' = 0.25$ at the entrance and as the outlet, No. 3, is similar to an open pipe, we let f be 1 at that point.

By plotting as in Fig. 10D, starting with the top line at 1, we stop at 4 and get the location of the atmospheric line. The static line has been drawn one velocity head, q, beneath the top line so then an extension of the atmospheric line back to the left gives 0.06 in. as the static pressure in the duct upstream from the grille.

Of course this answer could be had by simple arithmetic without the plot, but plotting clarifies the problem and acts to prove up the reasoning.

***Top*—Fig. 10A—Fan catalog pressures. *Center*—Figs. 10B, 10C, 10D—Illustrating pressure analysis at a supply grille. *Bottom*—Fig. 10E—Pressure plotting any problem**

Figs. 10A, 10B, 10C, and 10D use a base line at atmosphere for reference to simplify plotting. This method is not applicable to all problems, for it does not take into account changes in height or density of the fluid flowing through the circuit. The correct dimensions to use for plotting any problem are shown in Fig. 10E.

Plotting Any Problem

The static pressure in the pipe is shown as being absolute and a term called "elevation pressure" has been added. This elevation pressure is found by multiplying the height above a given datum times the density of the fluid in the pipe or flow path. You would have to use all the dimensions shown in Fig. 10E, if, for instance, you wished to analyze the flow through a chimney. The dimensions in Fig. 10E cover any problem.

In most problems, the dimension between lines Nos. 2 and 2A of Fig. 10E would prove too large for scaling on a sheet of paper so it could be broken and the other dimensions carried to correct scale. The formulas on Fig. 10E reduce everything to inches of water column. The dotted line No. 2A is the line used as a base line in Figs. 10A and 10D.

In plotting flow through a chimney, the path would start in the fire room, enter below the grate, through the combustion space, into the chimney, up the flue, outdoors, and around back down into the fire room. All this involves changes in altitude and density.

WSE MARKS 80TH ANNIVERSARY

The Western Society of Engineers recently celebrated its 80th anniversary and dedicated its new headquarters at 84 E. Randolph St., Chicago, in the John Crerar library property.

The program included an inspection of the newly completed space on the fifth, sixth, and seventh floors. On the seventh floor is an auditorium equipped with public address and picture projection systems and accommodating 300 persons. The sixth floor houses the staff offices and a comfortable lounge, and the fifth floor is devoted to dining facilities.

The WSE has a membership of about 2500.

Boeing Stratocruiser Has Air Recovery Unit

In the new Boeing Stratocruiser, activated carbon air recovery goes aloft for the first time, according to H. T. Porter, vice president of the W. B. Connor Engineering Corp., New York City. Air quality, or absence of odors, has to be considered in air conditioned aircraft as well as in ground installations; in the latter it poses no problem if cost of installing equipment capable of handling enough ventilation air is ignored. But in air conditioned aircraft, cost is a minor consideration. What is all-important is weight and size of the equipment. By incorporating activated carbon air purification in the air conditioning system of the Stratocruiser, Boeing engineers were able to make a relatively small and compact conditioning plant do the job of a larger one.

The double-decked Stratocruiser is the largest and most luxurious transport built to date, with a host of improvements in passenger convenience and comfort. Yet space, as in any public carrier, is comparatively confined and a normal odor generation is inevitable—from tobacco smoke, food service, and human origins. Control of the odor level was an important factor in the selection of the heating and cooling.

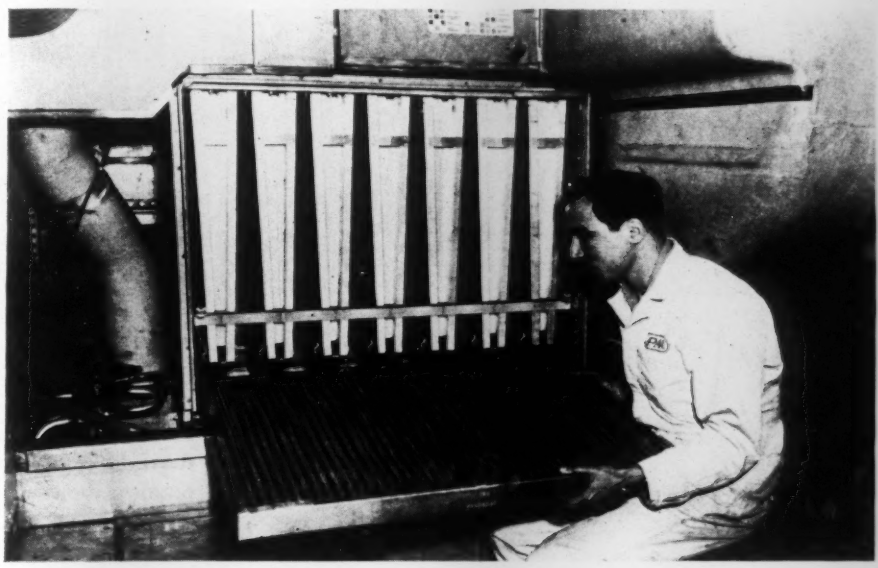
Temperatures as low as 80 deg below zero in the air and 120 deg above on the ground will be encountered by the Stratocruiser. Oxygen supply and carbon dioxide dilution required that the cabin air be held at a pressure not exceeding that of 5500 ft above sea level. To maintain comfort, pressure, and a "fresh air" environment with a minimum of conditioning equipment was the design objective.

It was established that the new outside air mandatory for pressurization was equivalent to 10 cfm per passenger and crew member under all flight conditions. But—for atmosphere quality—40 cfm, or, based on an occupancy of 90 persons, 3600 cfm of fresh air was needed. A high ratio recirculating system and the only satisfactory method of its utilization—high efficiency air recovery—was thus indicated.

An activated carbon air recovery unit which effectively removes odors from the air in recirculation was developed. Weighing but 33 lb and requiring only 1.3 cu ft of space, this device makes it possible to limit the outside air intake to 1000 cfm, about 25 percent of the total fan volume, although the cabin air is changed every 90 sec.

Other information on the air conditioning of this big plane was given in a short article on page 82 of the May HPAC.

Emerging from fiber glass filters, the recirculated cabin air then passes through three rows of tubes containing activated carbon to remove odors, thus permitting the re-use of conditioned air



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HOW TO INSULATE Steam Tracer Piping

RODGER HARRISON, Armstrong Cork Co., Lancaster, Pa., briefly describes and illustrates two alternate methods of insulating a steam traced pipe line carrying hot liquid asphalt from a storage tank to production

THERE ARE many factors which have a direct bearing on what might appear to be a routine pipe insulation job. Carefully computed factors of temperature and heat loss must be weighed against considerations of economy and durability. All these conditions vary with each job, leaving the engineer, contractor, or architect with the final decision on proper erection specifications.

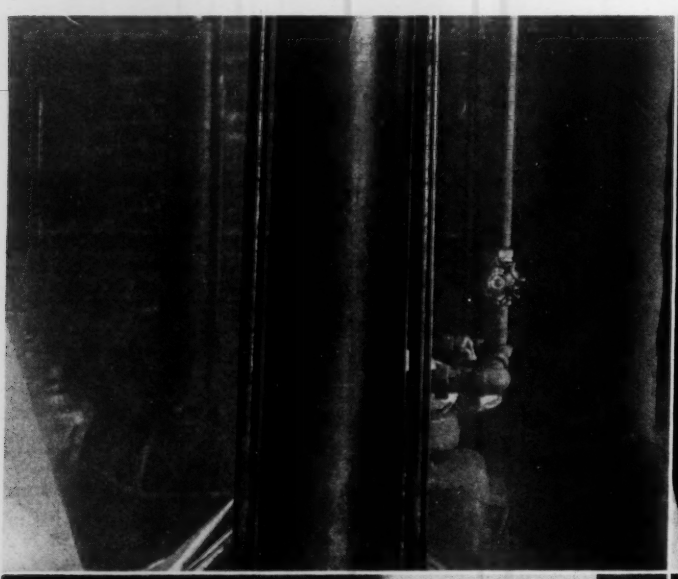
The steam traced pipe line shown in the accompanying illustrations was installed to carry hot liquid asphalt at 470 F from a storage tank into a production department. Steam tracer lines were erected on each side to prevent the asphalt from "freezing" in the pipe run.

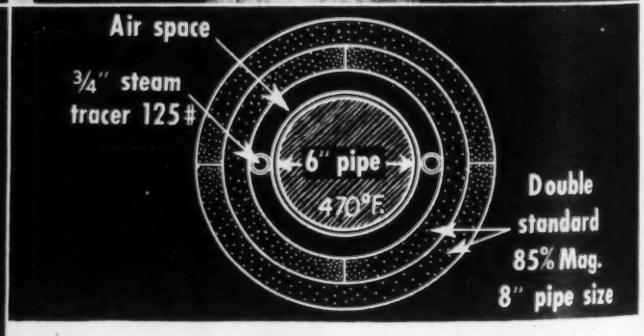
Two methods of insulating this line presented themselves. Double standard thick 85 percent magnesia pipe covering, 8 in. size, could be applied around all three pipes, as indicated in the diagram. This would leave an air space between the insulation and pipe lines, which would minimize heat loss and allow maximum uniformity of heat transfer between the tracers and the asphalt line.

Calculations on this particular job, however, indicated that these factors would result in negligible heat loss economies in long-term performance. So an alternate pipe covering specification was selected as illustrated in the photographs.

An inner layer of double standard thick magnesia pipe covering, 6 in. size, was cut to a snug fit between the two tracers and wired firmly in place against the parent line. The outer layer of pipe covering was then applied, rotated 90 deg to the first, with end joints staggered.

Obviously this specification makes a strong job mechanically. Furthermore there is a considerable saving in material costs obtained by using molded insulation of the smaller size.





One method of insulating would be to use pipe covering, 8 in. size, around all three pipes, as sketched here. Another method of insulating is shown in the three photos. An inner layer of pipe covering, 6 in. size, was cut to snug fit between the two tracers and wired firmly in place against the parent line. The outer layer of pipe covering was then applied, rotated 90 deg to the first, with end joints staggered

How to Evaporate Water in a Manufacturing Process

Final operation in the manufacture of cold synthetic rubber is putting a talc powder on the surface to facilitate handling, and as dusting creates a hazard the bales are dipped in a slurry of talc and water, said "F.R.Y." in a question published in the May issue. He asked for suggestions on getting rid of the excess water, and several readers have sent in ideas, some of which are published here

QUESTION OF THE MONTH

YOU ARE invited to submit a heating, piping, or air conditioning question for publication here. You are also invited to submit answers to previously-published questions from others. Write the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

IN REPLY to the question raised by "F.R.Y." in the May issue on the best way to evaporate excess water in an industrial process, there are several thought-provoking solutions that arise, each with its own merit.

The premise of the question is that dust creates an occupational hazard. It is upon this premise that the rest of the question is based. However, this situation can be simply solved with an exhaust system as is used in any paint spraying booth. Each bale, 7 x 14 x 28 in., must be covered with talc at the rate of one bale each 20 sec. Whether the bale is resting on a roller conveyor or is suspended from a conveyor is not essentially important. But, in either case, the conveyor could be enclosed on all six sides with flexible canvas openings at each end to permit entrance and exit of the bales; and an exhaust fan, or blower, could supply all the negative pressure to prevent drift of talc into the occupied adjacent spaces. The discharge from the blower could be caught in a dust collector or filters. To the writer, this solution seems to be the most direct approach to eliminate the undesired quantity.

However, if for reasons unknown, the preceding fails to be a practical solution to the problem, then there remain three other approaches, namely: heat drying, induction drying, and vacuum drying.

Heat drying may be broken down into two classes: hot air drying in a semi-closed oven using the usual calculations of required entering and leaving dew point of heated air to effect the desired drying rate, or, infra-red heat drying from infra-red electric bulbs spaced longitudinally and laterally to produce the desired degree and rate of drying. In the hot air drying system the available 15 psi steam can be employed advantageously in a blast heater located at the leaving end of a tunnel shaped drying oven.

Induction drying could be accomplished without the necessity of enclosing the conveyor. The principle to be used would be improved by being enclosed, however. Substantially, the vapor pressure of the surface water would be raised sufficiently to effect the degree and rate of required drying.

Vacuum drying presents a most interesting but the least practical method suggested. An interesting sidelight that came about through the speed-up requirements of the war was to find, or invent, a continuous process vs. the batch proc-

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ess used in refining petroleum products and producing high octane gas. Some of the methods developed were most ingenious. In developing the vacuum drying thought and, in particular to maintain a continuous motion of the conveyor of the rubber bales, the writer offers the following.

Steam ejectors (if a system is correctly designed) are capable of producing high vacuums using the 15 psi steam available. Under high vacuum, the excess water would boil out and off the bales at a desirable low temperature and thoroughly from all surfaces. These two features represent the greatest merit to the suggestion.

Next arises the question of how to get the bales into a container to retain the vacuum during the drying period. There are two apparent solutions: (1) to have a long, thin cylindrical container which could be opened and closed at both ends to take a batch of bales at one time. Each bale rests on a ½ or ¼ in. thick steel plate with roller skate bearing wheels on the bottom. The wheels run in a track on the inside of the cylinder. Movable magnets on the outside of the cylinder act to make the bales progress through the length of the cylinder. The detail of this theory could be elaborated but that would be the principle.

Or (2), a heavily cast five sided box could be located close over the conveyor to be brought down over each bale, sealed airtight to a plate the bale rested on on the conveyor.

In each instance, the exertion of a high vacuum available from an ejector would produce the necessary drying at relatively high and frequent intervals—considerably in excess of the movement rate of 20 sec.

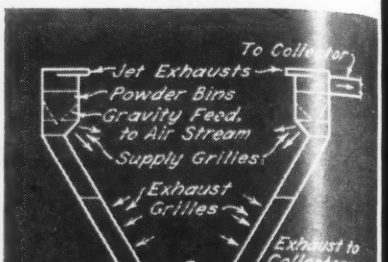
The vacuum drying theory is admittedly the least practical but gives the writer an opportunity to explore the possibilities that exist and reach the conclusion that the first solution, heat drying in an enclosed oven using a blast coil and the available steam, while prosaic would prove most satisfactory in the long run to the user.

A problem of this sort is not unusual. The first consideration is the removal of the "unwanted quantity." In this case, that is the free talc. The water is added in the slurry. The user, the rubber manufacturer, is the final judge of what will prove the most satisfactory method for his operation. But, going directly to the core of his problem, a change in the method of his process certainly seems to be strongly indicated.—S.M.

ELIMINATE THE WATER BEFORE IT'S USED

I submit the following in answer to the problem from "F.R.Y." published in the May issue:

It seems that the problem of moisture removal from the rubber product is one that has been created. If it were not necessary to remove the occupational hazard from dusting, the water would not be present. Once the water is present, the only way to remove it in a given time is by a combined control of temperature, humidity and air motion.



"D.E.R." has prepared this sketch as one method of using the scheme he suggests to solve the problem of removal of excess water in an industrial process

The control of humidity and temperature have practically been eliminated by "F.R.Y." in his statement that refrigeration or chemical dehumidification are too costly for this application and 140 F is the high temperature limit.

Therefore, under these conditions it seems the most economical solution is to eliminate the water before it is ever used, in this manner.

1) Construct a tank (size and shape dependent on surroundings).

2) Dry powder for dusting purposes is kept in suspension and circulation in the lower section of this tank by air motion.

3) Surround the perimeter of the tank on the leading edges with a jet exhaust duct.

The purpose of this duct is to pick up powder particles before they escape into the surrounding air. The powder picked up by this exhaust will be returned via a collector system to a powder bin in the lower section of the dusting chamber for re-use.

Since the jet exhaust will permit the top of the dusting chamber to be open without powder particles escaping, the procedure of dusting will be merely to pass the rubber through the turbulent powder area and out, the powder in suspension will adhere to the rubber and as it leaves the dusting area, in passing the jet exhaust on the leading edge, any excess will be removed.

Supply air will be of lower volume than exhaust in the dusting compartment, thereby creating a low pressure area to alleviate the problem of powder particles float-

Reader Asks for Some Data on Determining Duct Noise Levels

You are invited to answer the following question from a reader of HPAC. Suitable comment on the matter will be welcomed, and—space permitting—will be published. Sketches and photos are particularly desired. Address the Editor, Heating, Piping & Air Conditioning, 6 N. Michigan Ave., Chicago 2, Ill.

Here's the question:

"Where can I get information on predetermining the noise levels of air in sheet metal ducts with flush joints and average radius turns? To put my question in the form of a typical job problem, what will be the noise level in decibels of a 4 in. branch delivering 200 cfm? Assume the duct is of standard construction, duct elbows have average radius turns, and the duct joints are flush.

"I shall greatly appreciate any information on this subject."—J.W.H.

ing on a rising air stream. Those that do rise will be picked up in the high velocity exhaust surrounding the outer rim. The velocity of this exhaust is dependent on the free area of the open top and the specific gravity of the particles in suspension.

Powder may be returned to the bins from the collector system via a connecting duct and excess air exhausted to the atmosphere. If necessary the excess air may be passed through a spray or film of water to assure complete freedom of particles before disposal. It seems this method will eliminate:

1) The occupational hazard created by flying powder particles.

2) The slurry tank and dipping operation.

3) The drying problem.

4) The time element (as soon as the rubber is in and out of the chamber, it is ready for packing).

5) All problems of cost of drying, dipping, or maintenance (except fan operation).

The accompanying sketch shows a suggested layout for obtaining the above results.

There will be many methods of duct arrangement and equipment layout; therefore, I have not attempted to give any one specific design as being the only solution.

I sincerely hope this suggestion may be of value to "F.R.Y."—D.E.R.

USE RADIANT HEAT FROM ELECTRIC BULBS

In reply to "F.R.Y.'s" problem in the May issue of HPAC, since blowing air over the bales is out of the question because this would remove the talcum, the heat required for evaporating the water cannot be conveyed to it but must be radiated.

In this case, it cannot be done by means of the 15 psi steam, and electricity must be resorted to. Bulbs with the filament designed for this very purpose, and equipped with hexagon reflectors are available. These lamps radiate at an intensity sufficient for fast enough evaporation. Slow evaporation as could be effected by radiation from steam pipes surrounding the path of the bales would warm up the rubber.

Unless the bales are spaced far enough apart on the conveyor, extra bulbs must be arranged that radiate onto the end surfaces.

Theoretically, only 500 Btu per every 1½ min is to be radiated, equivalent to 6 kw. The bulbs, however, must be spaced at least 20 in. from the passing bales to allow for free dissipation of the vapor. This results in great losses—depending on ambient circumstances and conditions. I would start out with enough bulbs for consuming 5 kw per phase. A very slight artificial breeze may prove necessary under and above the bales.—S.R.

ASA METHYL CHLORIDE STANDARD 18TH IN SERIES

Engineering procedures now available can be used in putting into effect the new American Standard Allowable Concentration for Methyl Chloride, according to the American Standards Association, which has announced approval of the standard. This is the 18th in the series of national standards that define the amount of various toxic dusts and gases that can safely be permitted in the air of work places.

The standards are being developed under the procedure of the ASA by a committee of scientists and medical men with national reputations for work in improving industrial health conditions. William P. Yant, director of research, Mine Safety Appliances Co., is chairman of the sectional committee on allowable concentrations of toxic dusts and gases, Dr. C. D. Selby, medical consultant of the General Motors Corp., is vice-chairman, and Henry G. Lamb, safety engineer of the ASA, is secretary. The U. S. Bureau of Mines, as endorsing sponsor, recommended approval of the methyl chloride standard.

Has Widespread Use

Widespread industrial use of methyl chloride as a catalyst solvent in the synthetic rubber industry, as an extractant for greases, oils, and resins, and as a dewaxing agent in the petroleum refining industry has emphasized the need for defining the safe concentration for this compound.

According to members of the committee, the principal danger lies in the possibility that repeated exposures to low concentrations of methyl chloride will result in dangerous absorption by inhalation rather than that acute poisoning may result from a single exposure to high concentrations. Symptoms that may be encountered are increasing fatigue, loss of appetite, drowsiness, muscular weakness, staggering gait, mental confusion, vertigo, visual disturbances, nausea, slurred speech, convulsions, and coma.

In order to prevent injurious exposures, the concentration of methyl chloride in the breathing zone of exposed persons must be determined, and control measures put into effect where concentrations are found to be more than is permitted under the newly agreed upon allowable concentration.

"Past experience in handling methyl chloride in industry indicates that this standard is a practical one and can be met with engineering procedures that are now available," declares H. H. Schrenk, scientist director of the division of industrial hygiene, U. S. Public Health service, who was chairman of the subcommittee that developed the methyl chloride standard.

Other Standards Available

In addition to approval of the new standard on methyl chloride, action has been taken to make available for peacetime use the standards defining allowable concentrations for xylene, and for manganese, both of which were originally approved as American war standards in 1943. No changes have been made in the peacetime editions.

Other standards in this series define the allowable concentrations for carbon monoxide, hydrogen sulfide, carbon disulfide, benzene, cadmium, chromic acid and chromates, mercury, lead and certain of its inorganic compounds, toluene, oxides of nitrogen, methanol, styrene monomer, formaldehyde, and trichloroethylene.

Copies of the American Standard Allowable Concentration of Methyl Chloride, Z37.18-1949; American Standard Allowable Concentration of Xylene, Z37.10-1948; and American Standard Allowable Concentration of Manganese, Z37.6-1948 are available from the American Standards Association, 70 E. 45 St., New York 17, N. Y., for 35 cents each.

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DATA SHEET

*By F. W. Hutchinson**

Solar Irradiation of Walls and Windows South-Facing: October-April

THE HEATING AND air conditioning engineer—and the illuminating engineer—frequently require precise information as to the sun's position at a given time and place. Further, data are needed to permit rapid evaluation of the instantaneous rate of solar irradiation of walls and windows facing in various directions. This is the first in a series of four data sheets which will present in direct-reading tabular form solar angles, incidence angles, and irradiation rates as functions of time of day, month of the year, latitude of the structure, and orientation of the wall or window. By interpolation from the complete set of tables, the engineer will be able to determine without calculation the relative solar position and direct irradiation rate for any vertical wall at any daylight hour of the year.

Tables 1 through 4, presented this month, are—respectively—for latitudes of 30, 35, 40, and 45 deg (thus covering all of continental United States); these four tables are for a south-facing wall or window over the season from October 1 through April 30, a seven month period which in many localities is identified as the heating season. The hourly data in each table are based on exact conditions for the 21st day of the month in question, but for usual engineering computations they can be used with adequate accuracy for any other day of the same month. In terms of solar relationships (as contrasted with weather and with dry bulb temperature), conditions for January and November can be taken as the same and conditions for February and October as the same.

Table 1, for a south-facing vertical wall at latitude 30 deg, is representative in form of the first 12 tables of this series. The first column gives the month and the solar hour of the day; conditions given in following columns are those existing at the start of the stated hour. The second and third columns give the fundamental angles which determine the sun's position: the solar altitude, H, expressed in degrees of elevation above the true horizon and the solar azimuth, A, expressed in degrees east of north (up to 90 deg for due east) and south of east (up to 180 deg for due south at solar noon); for afternoon hours the azimuth values correspond to the number of degrees west of north. The angle, B, given in the fourth column is 180 deg less the azimuth, hence is equal to the horizontal angle between the direction of the sun's rays and a normal to a south-facing wall.

Angle of Incidence

The angle of incidence, i, is defined as the number of degrees between the actual direction of the sun's rays and a normal to the surface. By trigonometry the cosine of the angle of incidence must be equal to the product of the cosines of its vertical and horizontal component angles; hence, the value of cos i given in the seventh column is the product of the cosines of angles H and B; the value of i is then read from trigonometric tables.

The next to the last column gives the normal intensity, I_o defined as the Btu received in one hour (on a clear day) on one square foot of surface located at sea level and *normal* to the direction of the sun's rays. The evaluation of I_o depends on the turbidity of the earth's atmosphere, the sun's distance from the earth, and the solar altitude. Turbidity varies with weather and with locality and is indicative of the depletion of solar energy due to the scattering effect of dust and water vapor and the absorption effect of ozone, water vapor, and carbon dioxide.

For summer conditions within the United States, Moon† has proposed a curve of I_o versus solar altitude which is based on a dust concentration of 300 particles (assumed of uniform size equal to one micron) and on a fixed value of water vapor. Since winter temperatures are lower, a curve recommended for average winter conditions should be for an atmosphere containing less water vapor than in summer; such a curve, based on an absolute humidity of 27 grains of water vapor per pound of air has been proposed** and is used in selecting the I_o which appears in the tables for the months October through April. The recommended curve will not, of course, be exact for all localities at all times, but it is believed to be an approximation of adequate accuracy for engineering purposes.

The shape of the I_o vs H curve is assumed to be fixed, but the magnitude of the I_o values changes as the sun moves closer or farther from the earth. Maximum values occur in January, when the sun is a minimum distance from the earth; a decrement of 5 Btu per month has been assumed on either side of January.

Rate of Irradiation

The last column of the table gives the product I_o cos i which is the instantaneous rate of irradiation of unit area of south-facing wall or window. In using this value the designer must remember that "irradiation" refers to energy impinging on the surface and is not necessarily indicative either of energy entering the structure through a window or of energy actually absorbed by an opaque wall. The irradiation rate is, however, the basic term for use in evaluating either transmission or absorption.

*Professor of Mechanical Engineering, University of California, Berkeley, and Consulting Professor of Mechanical Engineering, Purdue University. This material is from a project on solar heating sponsored by the Libbey-Owens-Ford Glass Co. and carried on at Purdue University in cooperation with the Purdue Research Foundation.

†Parry Moon, Proposed Standard Solar Radiation Curves for Engineering Use, Journal of the Franklin Institute, November 1940.

**Hutchinson and Chapman, A Rational Basis for Solar Heating Analysis, ASHVE Journal Section, Heating, Piping & Air Conditioning, July 1946.

TABLE 1

South Wall — Latitude 30°

Solar Time	Solar Altitude H	Azimuth A	B = 180−A	cos H	cos B	cos i	i	Normal Intensity I_o	$I_o \cos i$
October									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	18	117	63	0.9511	.4540	0.4318	64.42	247.2	106.7
9am, 3pm	29	127	53	0.8746	0.6018	0.5263	58.24	279.0	146.8
10am, 2pm	39	141	39	0.7771	0.7771	0.6039	52.85	295.4	178.4
11am, 1pm	46	158	22	0.6947	0.9272	0.6441	49.90	305.1	196.5
12 Noon	49	180	0	0.6561	1.0000	0.6561	49.00	307.0	201.4
November									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	13	123	57	0.9744	0.5446	0.5306	57.95	214.9	114.0
9am, 3pm	24	133	47	0.9135	0.6820	0.6230	51.47	269.6	168.0
10am, 2pm	32	147	33	0.8480	0.8387	0.7112	44.67	288.2	205.0
11am, 1pm	38	162	18	0.7880	0.9511	0.7495	41.45	298.0	223.3
12 Noon	40	180	0	0.7660	1.0000	0.7660	40.00	301.0	230.6
December									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	11	125	55	0.9816	0.5736	0.5630	55.74	192.7	108.5
9am, 3pm	21	136	44	0.9336	0.7193	0.6715	47.82	264.9	177.9
10am, 2pm	29	148	32	0.8746	0.8480	0.7417	42.12	285.7	211.8
11am, 1pm	35	163	17	0.8191	0.9563	0.7833	38.44	296.5	232.2
12 Noon	37	180	0	0.7986	1.0000	0.7986	37.00	299.5	239.2
January									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	13	123	57	0.9744	0.5446	0.5306	57.95	220	116.7
9am, 3pm	24	133	47	0.9135	0.6820	0.6230	51.47	276	171.9
10am, 2pm	32	147	33	0.8480	0.8387	0.7112	44.67	295	209.8
11am, 1pm	38	162	18	0.7880	0.9511	0.7495	41.45	305	228.6
12 Noon	40	180	0	0.7660	1.0000	0.7660	40.00	308	235.9
February									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	18	117	63	0.9511	0.4540	0.4318	64.42	253.0	109.2
9am, 3pm	29	127	53	0.8746	0.6018	0.5263	58.24	285.7	150.4
10am, 2pm	39	141	39	0.7771	0.7771	0.6039	52.85	302.5	182.7
11am, 1pm	46	158	22	0.6947	0.9272	0.6441	49.90	312.4	201.2
12 Noon	49	180	0	0.6561	1.0000	0.6561	49.00	314.3	206.2
March									
7am, 5pm	10	97	83	0.9848	0.1219	0.1200	83.10	183.7	22.0
8am, 4pm	25	105	75	0.9063	0.2588	0.2345	76.44	273.6	64.1
9am, 3pm	37	116	64	0.7986	0.4384	0.3501	69.51	296.0	103.6
10am, 2pm	49	130	50	0.6561	0.6428	0.4217	65.06	310.7	131.0
11am, 1pm	56	152	28	0.5592	0.8829	0.4937	60.42	314.6	153.3
12 Noon	60	180	0	0.5000	1.0000	0.5000	60.00	315.6	157.8
April									
6am, 6pm	6	79	101	0.9945	-0.1908	—	—	—	—
7am, 5pm	20	87	93	0.9397	-0.0523	—	—	—	—
8am, 4pm	32	96	84	0.8480	0.1045	0.0886	84.92	284.8	25.2
9am, 3pm	44	105	75	0.7193	0.2588	0.1861	79.28	303.2	56.4
10am, 2pm	56	118	62	0.5592	0.4695	0.2625	74.78	310.9	81.6
11am, 1pm	66	140	40	0.4067	0.7660	0.3115	71.85	315.7	98.3
12 Noon	71	180	0	0.3256	1.0000	0.3256	71.00	318.6	103.7

TABLE 2

South Wall — Latitude 35°

Solar Time	Solar Altitude H	Azimuth A	B = 180−A	cos H	cos B	cos i	i	Normal Intensity I_o	$I_o \cos i$
October									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	17	118	62	0.9563	0.4695	0.4490	63.32	239.4	107.49
9am, 3pm	27	128	52	0.8910	0.6157	0.5486	56.73	275.2	150.97
10am, 2pm	36	143	37	0.8090	0.7986	0.6461	49.75	291.6	188.40
11am, 1pm	41	160	20	0.7547	0.9397	0.7092	44.83	299.3	212.28
12 Noon	44	180	0	0.7193	1.0000	0.7193	44.00	303.2	218.03
November									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	11	124	56	0.9816	0.5592	0.5489	56.71	190.5	104.56
9am, 3pm	21	135	45	0.9336	0.7071	0.6601	48.69	261.8	172.81
10am, 2pm	28	148	32	0.8829	0.8480	0.7487	41.52	281.4	210.68
11am, 1pm	32	163	17	0.8480	0.9563	0.8109	35.82	288.2	233.70
12 Noon	35	180	0	0.8191	1.0000	0.8191	35.00	293.1	240.08
December									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	10	126	54	0.9848	0.5878	0.5789	54.62	185.8	107.56
9am, 3pm	17	137	43	0.9563	0.7313	0.6993	45.63	245.1	171.40
10am, 2pm	24	149	31	0.9135	0.8572	0.7830	38.46	272.8	213.60
11am, 1pm	29	164	16	0.8746	0.9613	0.8407	32.79	285.7	240.19
12 Noon	31	180	0	0.8572	1.0000	0.8572	30.99	291.6	249.96
January									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	11	124	56	0.9816	0.5592	0.5489	56.71	195.0	107.03
9am, 3pm	21	135	45	0.9336	0.7071	0.6601	48.69	268.0	176.91
10am, 2pm	28	148	32	0.8829	0.8480	0.7487	41.52	288.0	215.62
11am, 1pm	32	163	17	0.8480	0.9563	0.8109	35.82	295.0	239.21
12 Noon	35	180	0	0.8191	1.0000	0.8191	35.00	300.0	245.73
February									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	17	118	62	0.9563	0.4695	0.4490	63.32	245.1	110.05
9am, 3pm	27	128	52	0.8910	0.6157	0.5486	56.73	281.7	154.54
10am, 2pm	36	143	37	0.8090	0.7986	0.6461	49.75	298.5	192.86
11am, 1pm	41	160	20	0.7547	0.9397	0.7092	44.83	306.4	217.30
12 Noon	44	180	0	0.7193	1.0000	0.7193	44.00	310.4	223.27
March									
7am, 5pm	10	98	82	0.9848	0.1392	0.1371	82.12	—	—
8am, 4pm	24	108	72	0.9135	0.3090	0.2823	73.60	269.6	76.11
9am, 3pm	35	120	60	0.8191	0.5000	0.4096	65.82	293.1	120.05
10am, 2pm	45	134	46	0.7071	0.6947	0.4912	60.58	307.7	151.14
11am, 1pm	52	155	25	0.6157	0.9063	0.5580	56.10	310.7	173.40
12 Noon	56	180	0	0.5592	1.0000	0.5592	56.00	314.6	175.92
April									
6am, 6pm	7	80	100	0.9925	—	—	—	—	—
7am, 5pm	20	90	90	0.9397	—	—	—	—	—
8am, 4pm	31	98	82	0.8572	0.1392	0.1193	83.15	284.8	33.98
9am, 3pm	42	108	72	0.7431	0.3090	0.2296	76.73	299.3	68.72
10am, 2pm	54	122	58	0.5878	0.5299	0.3115	71.85	309.0	96.25
11am, 1pm	62	146	34	0.4695	0.8290	0.3892	67.09	312.8	121.74
12 Noon	66	180	0	0.4067	1.0000	0.4067	66.00	315.7	128.39

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TABLE 3

South Wall — Latitude 40°

Solar Time	Solar Altitude H	Azimuth A	B = 180 − A	cos H	cos B	cos i	i	Normal Intensity I_o	$I_o \cos i$
October									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	15	118	62	0.9659	0.4695	0.4535	63.03	225.0	102.0
9am, 3pm	24	131	49	0.9135	0.6561	0.5993	53.18	266.5	159.7
10am, 2pm	32	145	35	0.8480	0.8191	0.6946	46.00	284.8	197.8
11am, 1pm	37	162	18	0.7986	0.9511	0.7595	40.58	292.5	222.1
12 Noon	39	180	0	0.7771	1.0000	0.7771	39.00	295.4	229.5
November									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	9	124	56	0.9877	0.5592	0.5523	56.48	175.9	97.1
9am, 3pm	16	136	44	0.9613	0.7193	0.6915	46.25	234.5	162.1
10am, 2pm	24	149	31	0.9135	0.8572	0.7830	38.46	269.6	211.1
11am, 1pm	28	163	17	0.8829	0.9563	0.8443	32.40	281.4	237.6
12 Noon	29	180	0	0.8746	1.0000	0.8746	29.00	282.3	246.9
December									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	9	126	54	0.9877	0.5878	0.5806	54.51	177.9	103.3
9am, 3pm	14	136	42	0.9703	0.7431	0.7210	43.86	221.4	159.6
10am, 2pm	20	151	29	0.9397	0.8746	0.8219	34.73	260.0	213.7
11am, 1pm	24	165	15	0.9135	0.9659	0.8823	28.08	272.8	240.7
12 Noon	25	180	0	0.9063	1.0000	0.9063	25.04	276.8	250.9
January									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	9	124	56	0.9877	0.5592	0.5523	56.48	180.0	99.4
9am, 3pm	16	136	44	0.9613	0.7193	0.6915	46.25	240.0	166.0
10am, 2pm	24	149	31	0.9135	0.8572	0.7830	38.46	276.0	216.1
11am, 1pm	28	163	17	0.8829	0.9563	0.8443	32.40	288.0	243.1
12 Noon	29	180	0	0.8746	1.0000	0.8746	29.00	289.0	252.7
February									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	15	118	62	0.9659	0.4695	0.4535	63.03	230.3	104.4
9am, 3pm	24	131	49	0.9135	0.6561	0.5993	53.18	272.8	163.5
10am, 2pm	32	145	35	0.8480	0.8191	0.6946	46.00	291.6	202.5
11am, 1pm	37	162	18	0.7986	0.9511	0.7595	40.58	299.5	227.5
12 Noon	39	180	0	0.7771	1.0000	0.7771	39.00	302.5	235.1
March									
7am, 5pm	9	98	82	0.9877	0.1392	0.1375	82.10	175.9	24.2
8am, 4pm	22	110	70	0.9272	0.3420	0.3171	71.51	263.8	83.6
9am, 3pm	32	123	57	0.8480	0.5446	0.4618	62.50	288.2	133.1
10am, 2pm	41	137	43	0.7547	0.7313	0.5519	56.50	302.9	167.2
11am, 1pm	47	157	23	0.6820	0.9205	0.6276	51.13	307.7	193.1
12 Noon	50	180	0	0.6428	1.0000	0.6428	50.00	309.7	199.1
April									
6am, 6pm	8	81	99	—	—	—	—	—	—
7am, 5pm	19	90	90	—	—	—	—	—	—
8am, 4pm	30	101	79	0.8660	0.1908	0.1652	80.49	280.0	46.2
9am, 3pm	41	112	68	0.7547	0.3746	0.2827	73.58	299.3	84.6
10am, 2pm	51	128	52	0.6293	0.6157	0.3875	67.20	307.0	119.0
11am, 1pm	59	152	28	0.5150	0.8829	0.4547	62.95	310.9	141.4
12 Noon	61	180	0	0.4848	1.0000	0.4848	61.00	311.8	151.2

TABLE 4

South Wall — Latitude 45°

Solar Time	Solar Altitude H	Azimuth A	B = 180 − A	cos H	cos B	cos i	i	Normal Intensity I_o	$I_o \cos i$
October									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	13	119	61	0.9744	0.4848	0.4724	61.81	214.9	101.5
9am, 3pm	22	132	48	0.9272	0.6691	0.6204	51.65	263.8	163.7
10am, 2pm	27	146	34	0.8910	0.8290	0.7386	42.39	278.4	205.6
11am, 1pm	32	163	17	0.8480	0.9563	0.8109	35.82	288.2	233.7
12 Noon	34	180	0	0.8290	1.0000	0.8290	34.00	291.1	241.3
November									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	8	125	55	0.9903	0.5736	0.5680	55.39	160.2	91.0
9am, 3pm	13	137	43	0.9744	0.7313	0.7126	44.55	214.9	153.1
10am, 2pm	17	150	30	0.9563	0.8660	0.8281	34.10	242.3	200.6
11am, 1pm	22	164	16	0.9272	0.9613	0.8913	26.96	263.8	235.1
12 Noon	24	180	0	0.9135	1.0000	0.9135	24.00	269.6	246.3
December									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	9	127	53	0.9877	0.6018	0.5944	53.53	177.9	105.7
9am, 3pm	11	139	41	0.9816	0.7547	0.7408	42.20	192.7	142.7
10am, 2pm	13	152	28	0.9744	0.8829	0.8603	30.65	217.5	187.1
11am, 1pm	18	165	15	0.9511	0.9659	0.9187	23.26	253.0	232.4
12 Noon	22	180	0	0.9272	1.0000	0.9272	22.00	266.9	247.5
January									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	8	125	55	0.9903	0.5736	0.5680	55.39	164.0	93.1
9am, 3pm	13	137	43	0.9744	0.7313	0.7126	44.55	220.0	156.8
10am, 2pm	17	150	30	0.9563	0.8660	0.8281	34.10	248.0	205.4
11am, 1pm	22	164	16	0.9272	0.9613	0.8913	26.96	270.0	240.6
12 Noon	24	180	0	0.9135	1.0000	0.9135	24.00	276.0	252.1
February									
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	13	119	61	0.9744	0.4848	0.4724	61.81	217.5	102.7
9am, 3pm	22	132	48	0.9272	0.6691	0.6204	51.65	266.9	165.6
10am, 2pm	27	146	34	0.8910	0.8290	0.7386	42.39	281.7	208.1
11am, 1pm	32	163	17	0.8480	0.9563	0.8109	35.82	291.6	236.4
12 Noon	34	180	0	0.8290	1.0000	0.8290	34.00	294.6	244.2
March									
7am, 5pm	8	101	79	0.9903	0.1908	0.1889	79.11	160.2	30.3
8am, 4pm	20	111	69	0.9397	0.3584	0.3368	70.32	256.9	86.5
9am, 3pm	29	124	56	0.8746	0.5592	0.4891	60.72	282.3	138.1
10am, 2pm	38	140	40	0.7880	0.7660	0.6036	52.90	298.0	179.9
11am, 1pm	44	160	20	0.7193	0.9397	0.6759	47.48	307.7	208.0
12 Noon	45	180	0	0.7071	1.0000	0.7071	45.00	308.7	218.3
April									
6am, 6pm	—	—	—	—	—	—	—	—	—
7am, 5pm	—	—	—	—	—	—	—	—	—
8am, 4pm	30	103	77	0.8660	0.2249	0.1918	78.93	293.0	56.2
9am, 3pm	39	117	63	0.7771	0.4540	0.3528	69.34	299.4	105.6
10am, 2pm	47	133	47	0.6820	0.6820	0.4651	62.29	304.1	141.4
11am, 1pm	54	154	26	0.5878	0.8988	0.5283	58.11	309.0	163.2
12 Noon	56	180	0	0.5592	1.0000	0.5592	56.00	310.9	173.8

SAM LEWIS' PAGE

Informal comment on heating, piping, and air conditioning matters is given in this regular feature by Samuel R. Lewis, consulting mechanical engineer, member HPAC's board of consulting and contributing editors

Improving Working Conditions In a Laundry With Ventilation

Many industrial buildings have interior areas where mechanical ventilation is absolutely essential. Mr. Lewis discusses the case of a large laundry, where the atmosphere for many of the employees was unsatisfactory, and explains how the situation was corrected by means of three separate air supply systems. . . . While on the subject of ventilation, he also answers a question from a reader on how to ventilate a kitchenette apartment

THERE ARE SOME large industrial buildings that have interior areas which are so remote from windows in outside walls that mechanical ventilation of these spaces becomes imperative. Some of the blackout buildings of World War II were permitted to have refrigerated and mechanically-induced air supply systems, and in such plants the relatively short ducts could be installed between the roof trusses or could be placed in penthouses above the roof so that all areas were well aerated. We designed several of these plants, one with more than 80 good sized apparatuses in overhead penthouses, and have followed the same scheme in a 20 acre 1949 machine shop.

Recently, a large, successful, and long-existing laundry demanded attention. The room is but one story high and without any basement. There are no definite interior walls. The various departments are open each to the other and materials in process are moved by many overhead conveyors. It is not customary —and possibly it is not expedient— to install a refrigerated air supply system in a commercial or public service laundry.

Three outside walls of this laundry have practically continuous windows with stools about 6 ft above the floor. The fourth outside wall is closed. The sash have horizontal center pivots so that the top of each sash swings inward. Over the central part of the building there is a monitor having continuous windows 6 ft high along each side. These windows also swing inward at the top, as is necessary to discourage the entry of rain. There are many ventilators on the roof.

In normal operation, the narrow fringe of people who work near the outside walls at the main floor level may receive some new outside air. The operatives who are inward, however, from this narrow fringe— mostly under the stepped-up monitor roof—become very warm and are subject to little air movement or air change. The inward-sloping window sash tend to divert all entering air upward along the ceiling, and the ventilators through the roof short circuit the air currents so that people along the floor feel very little air movement.

The solution was to bring about a definite and lively air replacement and movement near the floor through the entire working space. The air so moved is slightly cooler than the air around the bodies of the operatives. It should be free from dust and soot. If refrigeration is not to be employed, the volume and movement of the air from outside should be great enough to carry

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away a large proportion of the surplus heat from process and to evaporate rapidly the perspiration on the bodies of the workers. There should be means of considerable individual adjustment of air currents, both as to direction and volume.

Air Supply Systems Installed

To improve the conditions at the laundry, there were installed three separate air supply systems, each comprising a cell type air filter, a fan, and overhead distributing ducts run through and between the roof trusses and avoiding the conveyors and other obstructions.

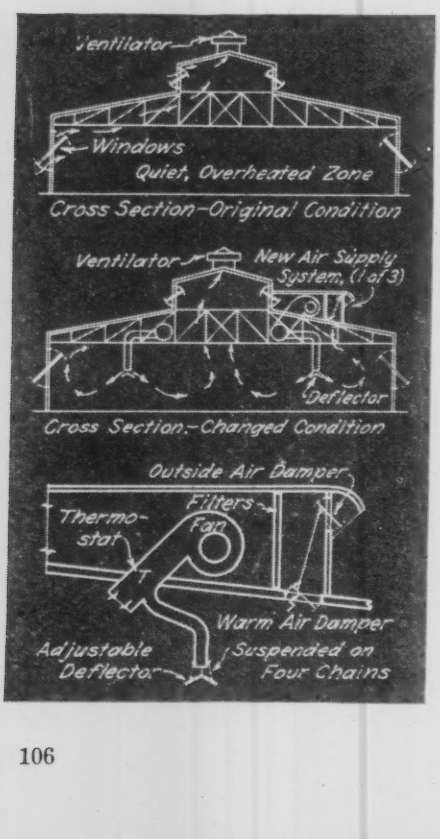
At the inlet to the filters in each system there are dampers, each controlled by a thermostat in the outlet duct from the supply fan and arranged to proportion outside air with recirculated air picked up close to the usually too-warm ceiling so that (by minimum readjustment and at no cost for heat) the delivered air temperature can be controlled. This temperature necessarily must not be much cooler than the air temperature in the working level. When the outside air temperature is cooler than, say, 65 F, enough air at 80 deg or thereabouts is taken from the room so that the resulting mixture may be at about 75 deg.

Removal of some of the too-warm air close to the ceiling also is beneficial. The delivered air emerges from downgoing branch ducts at a level about 8 ft above the floor, and these downcomers usually are not more than 12 ft apart.

Each branch duct has a volume damper at its junction with the main duct, and has an adjustable deflector at its bottom. This deflector is hung on four chains that permit varying the angle and direction and velocity of the delivered air. The relatively cool air thus reaches and sweeps out the too-hot, too-stagnant air remote from the windows.

The volume of mechanically delivered air in this laundry amounts to approximately 4 cfm per sq ft of floor in the zone served by each branch duct. The air, having picked up much of the surplus heat, rises to escape through the roof ventilators and when the wind direction permits, may escape through the monitor windows on the leeward side of the building.

Conditions in a large laundry were corrected by the installation of air supply systems, as sketched here



Ventilating a Kitchenette Apartment

While on the subject of ventilation, let us also consider the following problem from a reader of this page. This one refers to a kitchenette, which is without any windows. It is 8 ft high, 2 ft long, and 4 ft wide—just large enough for an equipment unit of stove, cabinets, sink, and refrigerator. There is a 7 x 2½ ft door leading out to the living room. The living room has four windows but little air passes into the kitchenette through the single door.

Apparently the kitchenette is a closet and is reached from the living room through the first door mentioned. This door is at one end of the kitchenette so that the air that might flow into the kitchenette when the door is open has no particular incentive so to do. When the door is closed, doubtless the kitchenette becomes warm and odorous.

Usually such apartments as this one are located in tall buildings and each kitchenette would be required by law to have an exhaust duct connected to a power driven fan. This outlet from the kitchenette to the exhaust duct properly should be overhead and in the end of the room most remote from the door. There could be a grille or louver in the door so that air from the living room constantly could pass into the kitchenette so as to carry away the heat and odors, whether or not the door is closed.

Reasonable Design Allowance

The air supply would be expected to enter the living room through the windows, or through doors from adjacent rooms, or by leakage around the loosely fitted window sash. A reasonable design allowance of air would be: Square feet of kitchenette floor area multiplied by four = cfm.

It may be that this kitchenette that requires ventilation is not in a multistory building having many such rooms. The physical conditions may not be such as to permit installing a conventional specialized exhaust fan in the attic or on the roof such as would be provided in a new, large building.

In such case, it is possible that the exhaust fan could be the direct-connected centrifugal type, placed inside the kitchenette overhead at the end most remote from the door. Such a fan would have an outlet duct about 5 in. in diameter and this duct might be extended through the roof. The fan motor switch could be in the living room, preferably with a bullseye pilot light, and the door from the living room to the kitchenette could have a grille or louver large enough to pass the air, or the door could be sawed off at the bottom to give, say, a 2 in. high crack for air entry.

If there are physical or political reasons that make it inexpedient to extend an exhaust duct through the roof, it would still be possible to install a quiet running propeller type fan high up in the wall between the kitchenette and the living room, as distant as possible from the kitchenette door. This door would have a grille or bottom opening for air entry from the living room and the fan, when running, would diffuse into the living room the surplus heat from the kitchenette.

Short of inspecting the building these suggestions for a happy solution of this problem may be worth consideration.

Heating, Piping & Air Conditioning

AMERICAN SOCIETY of HEATING and VENTILATING ENGINEERS

Journal Section

Air Streams from Perforated Panels

By Alfred Koestel*, Philip Hermann**, and G. L. Tuve†, Cleveland, Ohio

This paper is the result of research sponsored by the AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS in cooperation with the *Case Institute of Technology*

SUMMARY—Air streams discharged from perforated ceiling panels were investigated with special reference to the effect of such variables as the gross area of the panel, the size and spacing of the perforations, and the height of the ceiling. An equation describing the air-stream characteristics was derived analytically, and test results were found to conform with the momentum theory for stream velocities above 200 fpm. Below this value, viscous forces were involved in decreasing the stream velocity. Measurements were made with calibrated commercial anemometers of the heated thermometer, heated thermocouple, and bridled vane types. The air stream characteristics after diffusion were similar to those of outlets of 100 percent free area.

Correlation of the data with results by other investigators is indicated. A procedure for practical design is suggested, with examples to illustrate its use and limitations.

WHEN a stream of air is discharged from an outlet into still-air space, the velocity of an air particle in the primary jet may be decreased in three ways: (*a*) by dynamic or inertia forces; (*b*) by frictional or viscous forces; and (*c*) by buoyant or gravity forces. If the pressure is constant throughout the stream, the density of the air will vary only with temperature, and hence in an isothermal stream the buoyant forces are eliminated. The Reynolds number affords an index of the relative magnitudes of the two remaining forces, *i.e.*, the dynamic and the frictional forces.

Extensive data on air flow from many types and sizes of outlets have been presented in the previous reports in this series[1,2,3]. These experimental results were successfully correlated on the basis of the theory of conservation of momentum, since the tests represented relatively high outlet velocities and Reynolds numbers.

Air streams discharged from perforated panels of the types sketched in Fig. 1 have been found to behave in a manner similar to the streams from free-open outlets and from grilles, but lower velocities are usually involved. In fact, the perforated panel is an excellent device for producing a large-diameter stream that has a uniform velocity across its entire area. The tiny jets diffuse quickly, (Fig. 2), with a resulting

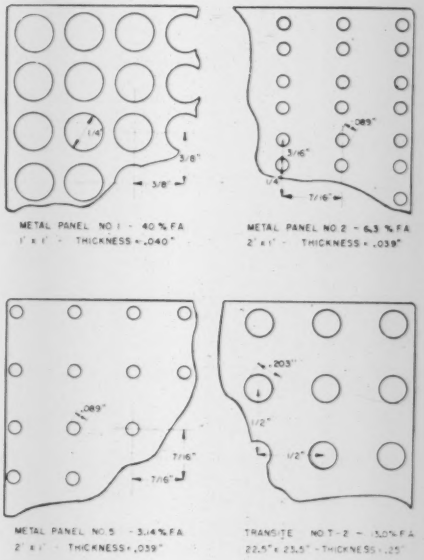

METAL PANEL NO. 1 - 40 % F.A.
1' x 1' - THICKNESS = .040"
METAL PANEL NO. 2 - 6.3 % F.A.
2' x 1' - THICKNESS = .039"
METAL PANEL NO. 5 - 3.14 % F.A.
2' x 1' - THICKNESS = .039"
TRANSITE NO. T-2 - 5.0 % F.A.
22.5" x 23.5" - THICKNESS = .25"

Fig. 1—Typical perforated panels tested

*Instructor in Mechanical Engineering, Case Institute of Technology. Junior Member of ASHVE.

**Instructor in Mechanical Engineering, Case Institute of Technology.

†Professor of Mechanical Engineering, Case Institute of Technology. Member of ASHVE.

[1,2,3] Exponent numerals refer to References.

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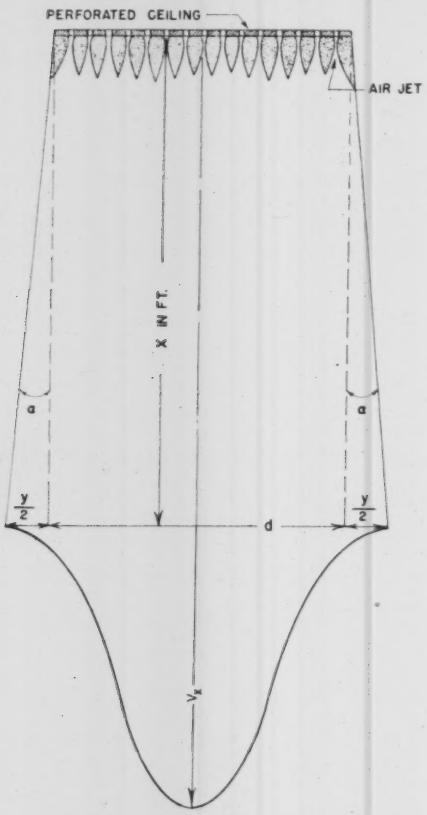

Fig. 2—Sketch of discharge air stream leaving perforated panel

uniform, low velocity equal to Q/A fpm, where Q is the volume in cubic feet per minute discharged through the panel and A is its gross area in square feet.

As the primary air stream progresses away from a discharge outlet, it passes through *three zones* or phases. These three zones have been investigated and described by McElroy[4], and the phenomena were confirmed in the present tests: *First zone,* near the outlet panel, the velocity in the center of the stream remains practically constant, and entrainment or mixing takes place only around the stream perimeter; *Second zone,* at a greater distance from the outlet, the maximum or centerline velocity decreases approximately as the square root of the distance. This zone is comparatively short. *Third zone,* the maximum residual velocity varies inversely as the distance X from the outlet, *i.e.*, $V_x/V_o = C/X$. This is the common equation for the throw of an air stream, as given in the HEATING, VENTILATING, AIR CONDITIONING GUIDE*. By the time the third zone is reached, the stream has become very nearly circular, irrespective of the shape of the outlet.

As the residual velocity and, hence, the Reynolds number of the stream in this *third zone* decreases, a point is finally reached at which viscous forces become important. As shown in Fig. 3, the actual velocities then fall below those indicated by the straight-line relationship. Previous reports in this series[1-3] have dealt chiefly with the character of air streams in the *third zone*, at velocities above that at which the viscous forces become significant.

In tests of nozzles and grilles, most of the measurements are made at a considerable distance from the panel, because this is the important part of the stream as far as air mixing, drafts and temperature gradients are concerned. But with perforated panels, which have a larger gross area, the zones close to the panel face are longer and become more important, hence for the panels in Fig. 1 all three of the characteristic zones have been investigated and the results are reported herewith.

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Theory and Analysis

Fig. 2 is a diagrammatic sketch showing the various air jets issuing from the perforations in a panel, and diffusing or flowing together near the panel face to form one homogeneous stream. This stream will eventually become circular, although if the panel is rectangular, a distance of several equivalent diameters may be traversed by the stream before it assumes the circular shape. In the following analysis, it is assumed that the diffusion of individual jets takes place into a stream area determined by the area of the panel. This assumption

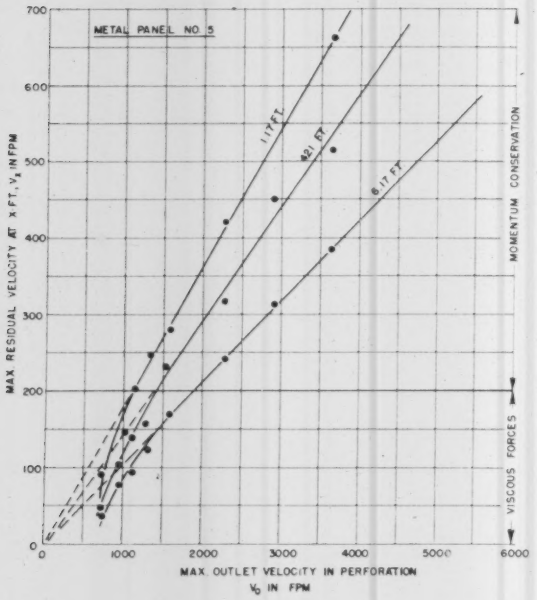

Fig. 3—Maximum residual velocity at a fixed distance from panel, as determined by heated thermometer anemometer

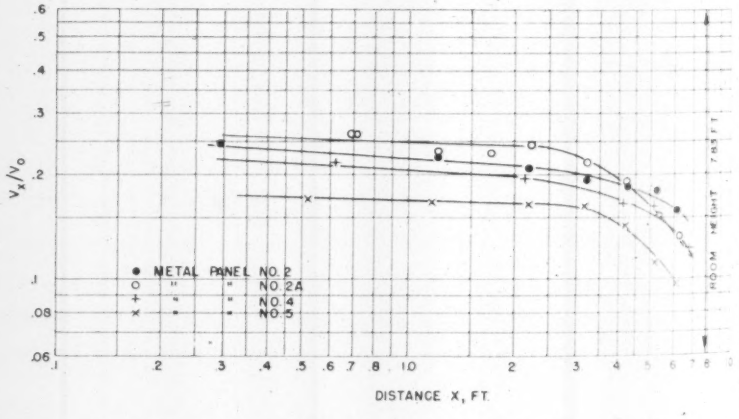

Fig. 4—Variation of center-line velocity V_x with distance; (air stream projected downward from an 8-ft ceiling with velocity V_o at perforations)

was supported by tests on several sizes and shapes of panels. (See Table 1).

The symbols to be used (see Fig. 3) are as follows:

X = Distance from panel face to V_x.

V_x = Maximum residual velocity of the discharge air stream at distance X from the panel.

V_o = Maximum outlet velocity at the jet contraction of the perforations.

(PA) = Gross *panel area* of the perforated panel.

α = Angle of expansion of the discharge air stream, assumed to be constant for all panels.

d = Equivalent diameter of the panel, $d = \sqrt{\frac{(PA)\,4}{\pi}}$

K_1 = Ratio of the average velocity of the discharge air stream at distance X to the maximum velocity V_x. $K_1 = \frac{V \text{ average}}{V_x}$

% (FA) = Percentage of *free area* or ratio of the total area of the perforations to the gross panel area. *Note:* Used as a decimal in the calculations.

C_d = Coefficient of discharge for the perforated panel.

$y = 2\ X \tan \alpha$

A_x = Circular area of the discharge air stream at distance X.

$$(d + y)^2 \frac{\pi}{4} = A_x$$

Writing the momentum equation in the form, $Q_o\ V_o = Q_x\ V_x$ for a perforated panel, the following analysis may be set forth:

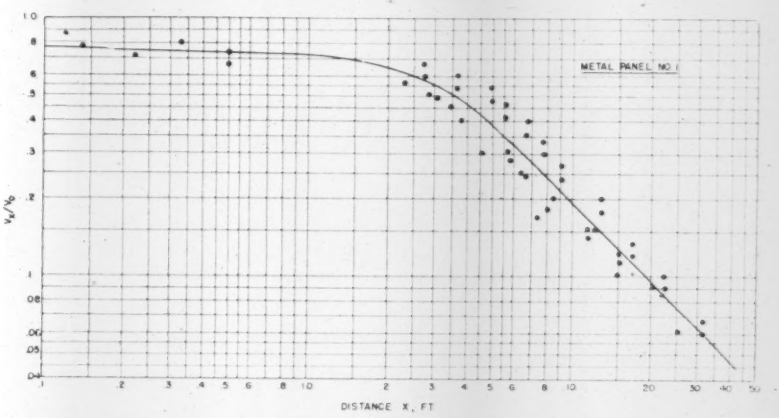

Fig. 5—Variation of center-line velocity V_x with distance (air stream projected horizontally into open space with velocity V_o at perforations)

Table 1—Description of Panels Tested

Panel Number	Panel Area Sq Ft	Percentage of Free Area	Material	Panel Thickness In.	Panel Dimensions In.	Hole Size In.	Average Coefficient of Discharge
1	1	40.5	Metal	0.040	12 × 12	0.25	0.83
2	2	6.30	Metal	0.039	24 × 12	0.089	0.75
2A	1	6.30	Metal	0.039	12 × 12	0.089	0.75
4	2	6.22	Metal	0.039	24 × 12	0.125	0.62
5	2	3.14	Metal	0.039	24 × 12	0.089	0.710
T-2	3.67	13.0	Fiberboard (transite)	0.25	22.5 × 23.5	0.203	0.75
T-3	14.65	13.10	Fiberboard (transite)	0.25	46 × 45.875	0.203	0.78
T-4	8.96	12.4	Fiberboard (transite)	0.25	$36\frac{1}{8} \times 35\frac{3}{4}$	0.197	0.79

Test Conditions: For Panel Nos. 1, T-2, T-3 and T-4, the air stream was projected horizontally into open space. For Panel Nos. 2, 2A, 4, and 5, the air stream was projected downward into an enclosed space. All panels were tested under isothermal conditions.

For the stream at a distance X from a given panel;*

$$\frac{V_x}{V_o} = \frac{\text{a constant}}{X}$$

*Heating, Ventilating, Air Conditioning Guide, 1949, Chapter 40—Air Distribution, p. 783.

$$V_o\left[V_o \times C_d \times \%\,(FA) \times (PA)\right] = K_1 V_x\left[K_1 V_x (d + y)^2 \frac{\pi}{4}\right]$$

$$V_o^2 C_d\,\%\,(FA) \cdot (PA) = K_1^2 V_x^2 \frac{\pi}{4} (d + y)^2$$

$$V_o \sqrt{C_d\,\%\,(FA)} \cdot \sqrt{(PA)} = K_1 V_x \sqrt{\frac{\pi}{4}} (d + y)$$

Substituting for y and d,

$$V_o \sqrt{C_d\,\%\,(FA)} \cdot \sqrt{(PA)} = K_1 V_x \sqrt{\frac{\pi}{4}} \left(\sqrt{\frac{(PA)\,4}{\pi}} + 2X \tan \alpha\right)$$

$$V_o \sqrt{C_d\,\%\,(FA)} = K_1 V_x \left(1 + 2 \tan \alpha \sqrt{\frac{\pi}{4}} \frac{X}{\sqrt{(PA)}}\right)$$

$$\frac{1}{K_1 \left(1 + 2 \tan \alpha \sqrt{\frac{\pi}{4}} \frac{X}{\sqrt{(PA)}}\right)} = \frac{V_x}{V_o} \frac{1}{\sqrt{C_d\,\%\,(FA)}} \quad \ldots\ldots\ldots\ldots (1)$$

Two dimensionless parameters are obtained from this derivation, *viz.* $X/\sqrt{\text{panel area (PA)}}$ and $1/\sqrt{C_d \text{ percent free area (FA)}}$, (see Equation 1), and these may then be used in correlating test data. This form of equation corresponds to Equation 25 presented by Rydberg and Norbäck[5].

A correlation of the test data on eight panels, based on Equation 1, is given herewith. The dimensions of the test panels are identified in Table 1. Stream velocities below 200 fpm are plotted separately, (Fig. 8), to indicate the magnitude of the viscous effects.

Since the two parameters of Equation 1 are constant for any given panel, it would be expected that a smooth curve should be obtained when the maximum residual velocity at a given cross-section is plotted against the distance from

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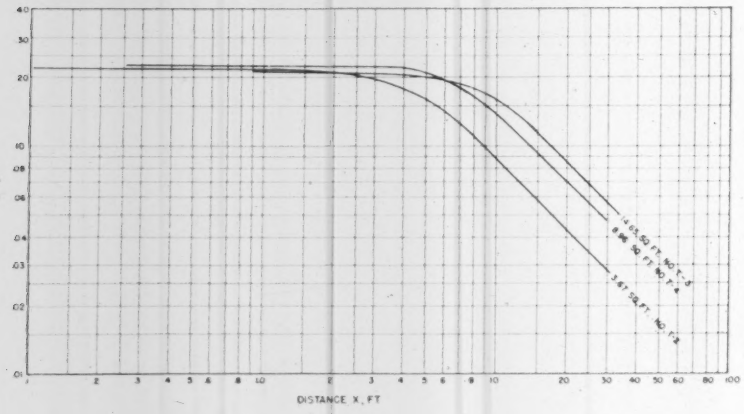

Fig. 6—Variation of center-line velocity V_x with distance, for various panel areas

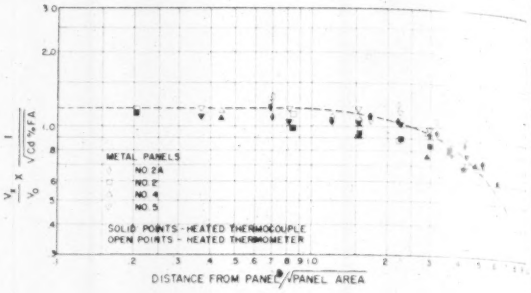

Fig. 8—Effect of viscous forces at low velocities (Dotted line from Fig. 7. Velocities between 40 and 200 fpm)

the panel face. This is confirmed by the curves of Figs. 4, 5, and 6.

Data and Results

A comparison of stream performance data from four perforated metal panels is presented in Fig. 4. Here the maximum residual velocity is plotted non-dimensionally against the distance from the panel face. The stream from the small, 1 sq ft panel (No. 2A) clearly attains the third phase or *third zone* in which the velocity decreases in direct proportion to the distance. The streams from the other panels which have an area of 2 sq ft, have barely completed the second or transition phase. In these tests the total throw distance was limited by the low ceiling height. The increased diffusion obtained by using a panel with a low percentage of free area is shown by the curve for Panel No. 5.

When the perforations occupy a large percentage of the gross panel area, the velocity in the *first zone* near the panel face remains high, as shown for a panel of 40 percent free area in Fig. 5. Since these test results were obtained by blowing horizontally into free-open space, the nature of the stream was not limited by floor-to-ceiling distance.

The effect of panel area is indicated by the direct comparisons of Fig. 6. These results were obtained with three transite panels of about 13 percent free area each, but with gross areas in the ratio of 1:2.5:4. The streams from the larger panels are projected a greater distance because of the greater length of each of the three stream zones or phases.

The correlation of test results for all eight perforated panels is shown in Fig. 7. Here the results are made directly comparable by expressing the distance from the panel face in effective diameters, $X/\sqrt{(PA)}$, and by multiplying the velocity ratio V_x/V_o by the diffusion parameter $\frac{1}{\sqrt{C_d\%(FA)}}$ (see Equation 1).

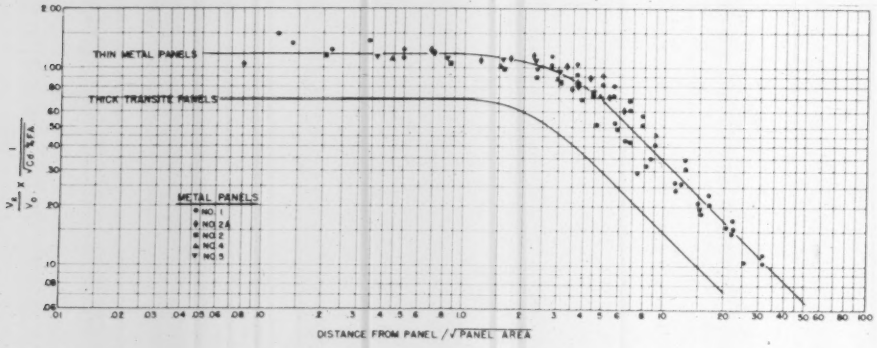

Fig. 7—Complete results of tests on 8 perforated panels, correlated by the use of dimensionless parameters

The panel thickness has a marked effect on the diffusion near the panel face, as shown by the lower curve for the relatively thick transite panels. This increase in diffusion explains the position of the horizontal part of the curves in Fig. 6, when these are compared with the curves of Figs. 4 and 5.

As already indicated in Fig. 3, the test points for residual velocities below about 200 fpm deviate from the curves of Figs. 4 to 7. These deviations are shown by Fig. 8, where the dotted curve (from Fig. 7) affords a direct comparison. Most of the experimental points fall below this dotted curve, as should be expected when viscous friction decreases the jet velocities. The test results from the heated thermometer and heated thermocouple are shown separately in this plot in order to present a comparison of the two instruments at velocities between 40 and 200 fpm.

Fig. 9 again presents the results of the four metal panels tested within the enclosed space, (see also Fig. 4). The heated thermometer and the heated thermocouple readings are shown separately in Fig. 9 to give another comparison of the two instruments, this time for velocities above 200 fpm.

Experimental Methods

Velocity traverses of the air stream were taken at several different distances from the face of the panel. Such runs were made at various static pressures using both a heated thermometer (thermo-anemometer, and a heated thermocouple of commercial type. To position the instruments, in the perforated ceiling

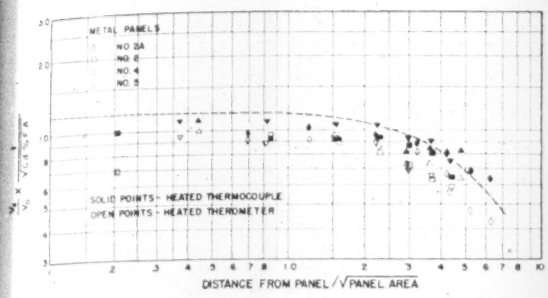

Fig. 9—Tests on four metal panels (Results from heated thermometer and heated thermocouple shown separately)

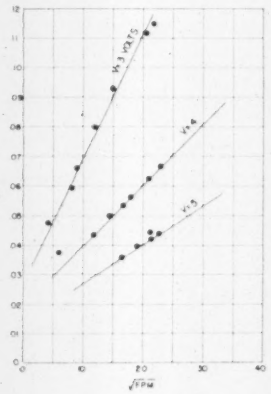

Fig. 10—Calibration of heated thermometer at various impressed voltages. (ΔT temperature difference between heated and unheated thermometer)

tests, an 84-in. square grid was suspended from the ceiling in such a manner that it could be set at any desired level from the floor and still be centered upon the perforated panel mounted in the ceiling. The grid was divided into 3-in. squares by fine thread.

The panels were mounted centrally in the ceiling which formed the lower side of a large plenum. The air discharged downward into an enclosed room approximately 18 × 12 × 8 ft, and was exhausted through large outlet grilles in the baseboard at one end of the room.

The procedure was to set the grid level and pressure differential and then take velocity readings with the heated thermocouple positioned in the stream. Readings were taken with the instrument pointing into the moving air stream at the center of each of the grid squares where the velocity was 50 fpm or better. The heated thermometer was used to determine the peak velocity at the location previously indicated by the heated thermocouple.

The calibration of these two instruments was similar to that procedure followed by Seigel[6] on anemometer calibration. The velocity distribution across the test section was very uniform. Air flow was measured by the pressure drop across a calibrated 4-in. orifice mounted downstream of the test section. A micromanometer which checked exactly with a hook gage was used to measure the pressure.

The heated-thermocouple anemometer consisted of series thermocouples mounted in the open-end of a half inch metal tube, with a provision for electrical heating of the hot junctions due to the electrical resistance of the fine thermocouple wire itself. The magnitude of the d-c thermal voltage generated by the pile is indicated on a calibrated dial reading in feet per minute.

The heated thermometer anemometer was identical to the one described by Yaglou[7]. It consists of two glass thermometers one of which is wound with a manganin wire heating coil about its bulb. A direct current is passed through the coil by impressing a controlled voltage (1.5 to 6 volt) with batteries. The heated thermometer is cooled by the air flow. The temperature difference between the heated thermometer and the ambient thermometer is dependent upon the air velocity. Thus, the higher the velocity the smaller the temperature difference.

The heated thermometer calibration curves (Fig. 10) show close agreement with the curves based on the equation developed by Yaglou[7]. The relationship is linear for all practical purposes.

The calibration curve for the heated thermocouple (Fig. 11) shows very close agreement between the indicated reading and the true reading from 85 to 220 fpm. This calibration was repeated about half way through the tests and the curve was reproduced, indicating that the instrument characteristics were constant with time.

The reading of the heated thermocouple anemometer was subject to the observer's judgment of a time average, under fluctuating conditions. Two observers could differ as much as 50 to 100 fpm for a given reading. This anemometer is more of a directional type instrument because of the nozzle-like shield around the thermocouple mounting. The heated thermometer is less directional and has a much greater mass and, therefore, gives a more completely integrated value. Because of these characteristics, the

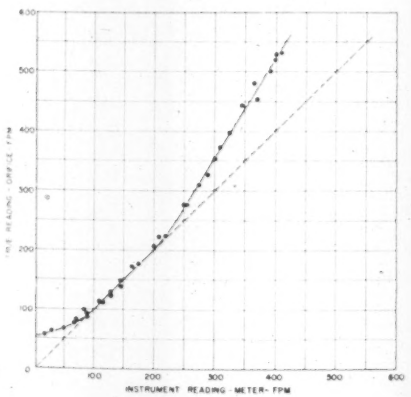

Fig. 11—Calibration of heated thermocouple

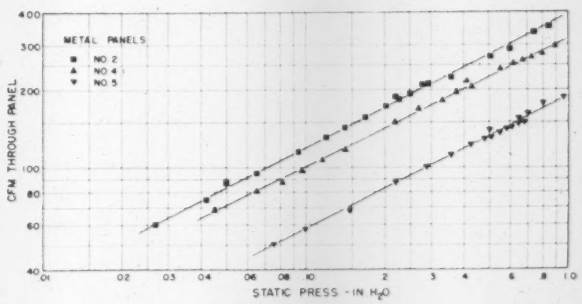

Fig. 12—Calibration of perforated panels on plenum chamber against standard orifices

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heated thermometer was preferred for use in determining average peak velocity.

The perforated panels were calibrated by mounting them on a large plenum chamber, metering the air by means of a calibrated orifice, and measuring the static pressures with calibrated inclined manometers. From these values a discharge coefficient was determined at various rates of flow. From Fig. 12 it is evident that the slopes of the curves are very close to 0.5 and indicate a nearly constant coefficient of discharge for a given panel.

In addition to the perforated metal panels, several perforated transite panels were tested. In this case, the air was discharged horizontally into an open space. The panels were mounted on a large plenum. The air flow was metered by means of an orifice, and pressure readings were taken from calibrated inclined manometers. A bridled vane anemometer was used for taking velocity measurements. The anemometer was mounted on a movable stand at center-line height of the perforated board. At fixed distances from the panel, velocity profiles were obtained. The perforated transite panels were calibrated similarly to the perforated metal panels.

Discussion and Conclusions

These test data on several types and sizes of perforated panels furnish a confirmation of the analysis used in deriving Equation 1. A method is, therefore, available for estimating the performance of perforated panels, within the range of conditions covered by these tests, *viz.*, 3 percent to 40 percent free area, 1 to 14 sq ft panel size, and up to 3500 fpm velocity through the perforations. Moderate variations in the panel shape or the hole spacing or configuration had no apparent effect on the performance. If tests were made on panels with very small holes, so widely spaced that the individual jets would be prevented from converging into a single stream, the results would no doubt be different, but such panels would usually not be practicable.

It will be noted that when the ratio of velocities V_x/V_o for the thin metal panels was multiplied by the diffusion parameter $\frac{1}{\sqrt{C_d\%\,(FA)}}$ the result was greater than unity.

For the *first zone* near the panel this product was about 1.18. McElroy termed this ratio, in the *first zone*, the *center constant* and also reported values above unity[4], (between 1.0 and 1.2 depending on the conditions of approach). The length of the *first zone* or phase was somewhat shorter in the present tests than those given by McElroy. The *center constant* for the thick transite panels was found to have a much lower value, approximately 0.72. This was probably due to the occurrence of the jet contraction and the re-expansion within the perforations instead of a normal expansion in the discharge space as is the case for the thin metal panels. The fuzziness of the holes may also have been a contributing factor.

In the case where low residual velocities are desired near the panel discharge, for large volumes of primary air supply, the optimum panel design and arrangement would be obtained if panels of small area and low percent free area were spaced in such a way as to prevent the streams of each outlet from converging and forming higher stream velocities. With such small panel areas the phase lengths are decreased, and with low free areas the diffusion is increased.

When curves such as those in Fig. 7 are used for design purposes involving residual velocities below 100 fpm, they will give results on the safe side. On the other hand the curves must be used with care for cooling applications. The velocity ratio $(V_x/V_o/\sqrt{C_d\%\,(FA)})$ is essentially equal to the ratio of temperature gradients, hence if $(V_x/V_o/\sqrt{C_d\%\,(FA)})$ is near unity within the zone of occupancy, only a very small temperature difference is permissible if drafts are to be avoided. However, if low values of $(V_x/V_o/\sqrt{C_d\%\,(FA)})$ are reached, say 0.1 to 0.3, before the stream enters the zone of occupancy, the temperature of the air discharged from the perforations may be correspondingly lowered below the temperature of the room.

Further investigation of the non-isothermal conditions is desirable to establish the design criteria for heated air and cooled air. Further research, of interest from both the theoretical and practical viewpoints, should be conducted on (*a*) stream shapes and profiles; (*b*) effects of hole spacing and aspect ratio; and (*c*) flow in the viscous and transition regions (*second zone*). This further work will give a more firm basis for determining the best size and spacing of perforated panels for year-round air conditioning.

Design Example

Given

A room is to be supplied with conditioned air at a rate equal to 1.5 cfm of air per square foot of gross floor area. Perforated ceiling panels will be used and two styles are available, one with 5 percent free area, the other with 15 percent free area. The residual air velocity at a level 6 ft above the floor must not exceed 75 fpm. Two possible ceiling arrangements are to be considered:

1. Low Ceiling Arrangement. A furred ceiling will be used with a floor-to-ceiling height of 8 ft.

2. High Ceiling Arrangement. The floor-to-ceiling height will be 20 ft.

Required

The selection of panel sizes and air velocities through the perforations. No air-supply panel is to exceed 48 in. in length (or width).

Solution (based on Fig. 7)

V_x in all cases is 75 fpm. (The residual velocities determined from Fig. 7 will give conservative values for velocities below 200 fpm.)

Assume $C_d = 0.75$ for both panels.

The diffusion parameters for the two panels are:

5 Percent (FA) Panel,

$$\frac{1}{\sqrt{C_d \times \%\,(FA)}} = \frac{1}{\sqrt{0.75 \times 0.05}} = 5.15$$

15 Percent (FA) Panel,

$$\frac{1}{\sqrt{C_d \times \%\,(FA)}} = \frac{1}{\sqrt{0.75 \times 0.15}} = 2.98$$

The air quantity flowing from each panel is:

$$\text{cfm} = (\text{PA})\ \%\,(\text{FA})\ C_d V_o$$

The static pressure required for each panel is determined from the V_o in the perforations:

$$V_o = \sqrt{2gh}$$

Tabulated Results of Computations

8 Ft Ceiling $X = 2$ Ft	Panel Size—Feet 1 × 1	2 × 2	4 × 4
$\frac{X}{\sqrt{(PA)}}$	2	1.0	0.5
$\frac{V_x}{V_o} \frac{1}{\sqrt{C_d \% (FA)}}$	1.1	1.2	1.2
V_o at 5 percent (FA) fpm	351	322	322
Static pressure required, inches H_2O	0.008	0.006	0.006
Cfm at 5 percent (FA) per panel	13.2	48.4	193.0
Square feet of floor area served per panel	8.8	32.2	129.0
Percent of ceiling to be perforated	11.4	12.4	12.4
V_o at 15 percent (FA) fpm	203	186	186
Static pressure required, inches H_2O	0.003	0.002	0.002
Cfm at 15 percent (FA) per panel	22.8	83.6	335.0
Square feet of floor area served per panel	15.2	55.6	223.0
Percent of ceiling to be perforated	6.6	7.2	7.2

Tabulated Results of Computations

20 Ft Ceiling $X = 14$ Ft	Panel Size—Feet 1 × 1	2 × 2	4 × 4
$\frac{X}{\sqrt{(PA)}}$	14	7	3.5
$\frac{V_x}{V_o} \frac{1}{\sqrt{C_d \% (FA)}}$	0.25	0.48	0.87
V_o at 5 percent (FA) fpm	1540	804	443
Static pressure required, inches H_2O	0.144	0.040	0.012
Cfm at 5 percent (FA) per panel	57.7	120.5	266.0
Square feet of floor area served per panel	38.5	80.3	177.3
Percent of ceiling to be perforated	2.6	4.98	9.01
V_o at 15 percent (FA) fpm	894	466	257
Static pressure required, inches H_2O	0.048	0.013	0.004
Cfm at 15 percent (FA) per panel	100.0	210	462
Square feet of floor area served per panel	66.9	139.2	308
Percent of ceiling to be perforated	1.5	2.9	5.2

Selection

On the basis of the tabulated results, for the conditions given in this example, the most economical selection of the panel type would be based on the percentage of ceiling to be perforated and on the static pressure required for a given quantity of primary air. The required panel area would be an indication of the installation costs, and the air quantity and static pressure would determine the cost of operation (supply fan power).

In all cases, the 1 × 1 ft panel is the most economical from the standpoint of panel surface required. The static pressures for the 1 sq ft panels are greater than those of the larger panels, thus indicating higher required fan power, but all pressures are low, so that this factor may be neglected in any economic considerations for this example. The amount of mixing of the primary air would also be more complete because the mixing lengths are smaller for the 1 × 1 ft panels than for the larger panels.

Other factors beyond the scope of this paper may be entailed in this particular design example. For example, the values of the ratio, $X/\sqrt{(PA)}$, for the 8 ft ceiling are relatively low, and indicate that the residual velocity is in the first phase or mixing zone in which the center velocity remains constant with distance. If the temperature of the discharge air in this case were much below that of the room, the lack of mixing of primary air with relatively warm secondary air may produce conditions of discomfort to any occupants located below the center of the perforated panel.

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PERSONALS

Thomas H. Urdahl, consulting engineer, 734 Jackson Pl., N.W., Washington, D. C., has announced the continuation of his consulting practice specializing in heating, air conditioning, power plant and industrial design. Mr. Urdahl started in private practice in 1926, and served in the Navy during World War II.

Lin J. Krause has formed the L. J. Krause Co. of Minneapolis, to act as manufacturers' agent in several North Central States. He was formerly Register Division Manager of Minneapolis-Honeywell Regulator Co., Minneapolis.

NEW YORK LEADS IN INDUSTRIAL OUTPUT

Ten states contain two-thirds of the nation's factories, according to a report issued recently by the U. S. Census Bureau. The ten states are: New York, Pennsylvania, Illinois, Ohio, Michigan, New Jersey, California, Massachusetts, Indiana and Wisconsin.

Since 1939, California has moved from 8th to 7th place among the ten, and Wisconsin has taken Connecticut's place as Number 10. The ranking is according to dollar value, added by manufacture. The survey included more than 200,000 plants, of which nearly 154,000 were located in the ten states.

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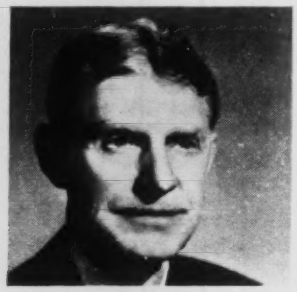
Dr. Woods Heads Joint Committee on Psychrometric Data

An important step toward international agreement on standard thermodynamic properties of moist air in the range of pressures and temperatures of interest to the aerodynamic, the air conditioning, and the chemical engineer, and to the meteorologist was taken on May 12, 1949, by members of the Inter-



Dr. Baldwin M. Woods
Berkeley, Calif.

national Joint Committee on Psychrometric Data who met under the chairmanship of Dr. Baldwin M. Woods, past president of ASHVE and director of University Extension, University of California, Berkeley.

Meeting in the Towne Scientific School, University of Pennsylvania, Philadelphia, the Joint Committee voted unanimously to accept the final report of its working subcommittee. In effect this report recommends a formulation of the thermodynamic properties of moist air which is claimed to be valid over a considerable range of pressure and temperature and to be thermodynamically consistent within the accuracy of existing data. Essential ingredients of the formulation are represented in the form of skeleton tables with recommended tolerances. Recommendations regarding best values of the relevant physical constants and conversion factors are made; dry air is defined in terms of a fixed, mol-fraction composition.

The Joint Committee also considered some questions of terminology. In particular, it voted to recommend that the term *specific humidity* be discarded and the term *humidity mixing ratio* used instead to designate the weight of water vapor per unit weight of dry air, with the understanding that the latter may be contracted to *mixing ratio* when no ambiguity is introduced thereby.

Regarding relative humidity, the Joint Committee was inclined to favor the redefinition recently adopted by the International Meteorological Organization (IMO), namely, the ratio of the given humidity mixing ratio to the humidity mixing ratio at saturation with respect to *liquid* at the given temperature and pressure. The Joint Committee was fully aware of the fact that at any given temperature there is a lowest pressure and at any given pressure a highest temperature for saturation with respect to liquid so that, according to the IMO redefinition, relative humidity is not defined at or outside the boundary of this region. The Joint Committee was inclined to feel that this restriction is a valid one and that no practical advantage is to be gained by attempting to remove it. The Joint Committee invites comments and suggestions on this important question for study pending the formulation of a definite recommendation.

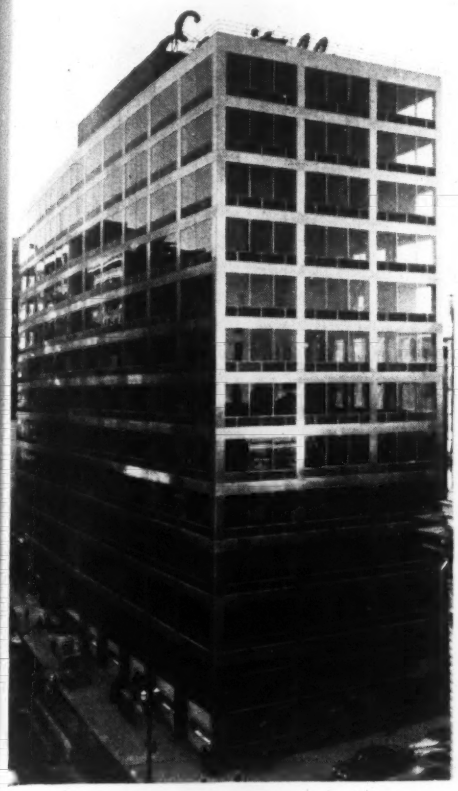
The final report of the working subcommittee also outlines the overall problem before the Joint Committee as consisting of three main parts: (1) to obtain information regarding the thermodynamic properties of moist air which can claim general acceptance as standard on the ground that it is thermodynamically consistent within the accuracy of existing knowledge; (2) to develop specifications of standard instruments for the practical realization of these properties in the field; (3) to recommend standard symbols, terminology, and charts calculated to promote a better understanding of underlying theory in its application to practical problems involving moist air.

Dr. Woods was made temporary chairman of the International Joint Committee on Psychrometric Data

John A. Goff
Philadelphia, Pa.

to succeed the late J. H. Walker. The working subcommittee is composed of: Dean John A. Goff (chairman), Towne Scientific School, University of Pennsylvania; C. S. Cragoe, National Bureau of Standards; L. P. Harrison, U. S. Weather Bureau; F. G. Keyes, Massachusetts Institute of Technology. Prof. S. Gratch, Towne Scientific School, University of Pennsylvania, served the subcommittee as technical adviser.

Members of the Joint Committee who attended the May 12 meeting are as follows: B. A. Dmitrieff, *American Society of Mechanical Engineers;* John A. Goff, American Society of Heating and Ventilating Engineers; L. P. Harrison, U. S. Weather Bureau; S. G. Rison, British Commonwealth Scientific Office; J. L. York, *American Institute of Chemical Engineers;* C. S. Leopold, *American Society of Refrigerating Engineers;* and Dr. Woods. S. Gratch, Towne Scientific School, University of Pennsylvania, was also present by invitation.



Heat Pump Results in Equitable Building

By J. Donald Kroeker*, Ray C. Chewning† and Charles E. Graham**, Portland, Ore.

Fig. 1—The Equitable Building, Portland, Ore.

SUMMARY—After operation of a heat pump installation for a period of one year, operating results and comparisons with predicted demands are given with reference to the heating period. Methods of obtaining data are outlined and coefficients of performance are obtained indicating that intelligent use of proper operating data and control equipment can save $150 to $200 a month in the installation described.

In a previous paper[1], it was stated *it is contemplated frank comparisons will be made between actual operating experience and costs as against those predicted from careful analysis during design*. Such comparisons are the purpose of this paper.

The Equitable Building, Portland, Ore., heat pump system, at present the largest in an office building in the United States, has been in operation for a complete year, although the building has not been fully completed or occupied during that period. Many requests for data on operation of this heat pump have been received. Complete data applicable to operation over a normal season coincident with normal building use are not yet available. However, sufficient data have been assembled to permit reliable comparisons which are not expected to change significantly as a result of further studies. Accurate cost comparisons cannot be made at this time for reasons which will be discussed.

The discussion of the operating results and comparisons is confined to those factors applicable to the heating phase, inasmuch as use of refrigeration equipment for the heating service is the only point of interest in the installation. Comments are also included on factors believed important in design of a commercial heat pump system.

Building and System Described

A brief general description of the building and system is necessary for this discussion. The building, Fig. 1, is a 12-story rental office building with a plan area 100 ft × 260 ft for the basement, first and second floors; 60 ft × 200 ft for the third through the 12th floors; a 13th set back floor approximately one-half the latter area; and two penthouse levels housing air conditioning and elevator equipment. The building is of reinforced concrete construction, with aluminum facing. Double-pane windows extend from column to column. The exterior pane is made of heat absorbing glass, which reduces the heat loss due to glass by 50 percent and the heat gain by 40 percent.

The entire building is completely air conditioned, using an all air system to avoid higher first cost of a split system. The heat pump which furnishes the heating and

*Consulting Engineer. Member of ASHVE.
†Office of J. Donald Kroeker. Member of ASHVE.
**Building Engineer, Equitable Building.
[1] A Heat Pump in an Office Building, by J. Donald Kroeker and Ray C. Chewning. (ASHVE Journal Section, *Heating, Piping & Air Conditioning*, March 1948, p. 121.)
Presented at the Semi-Annual Meeting of the American Society of Heating and Ventilating Engineers, Minneapolis, Minn., June 1949.

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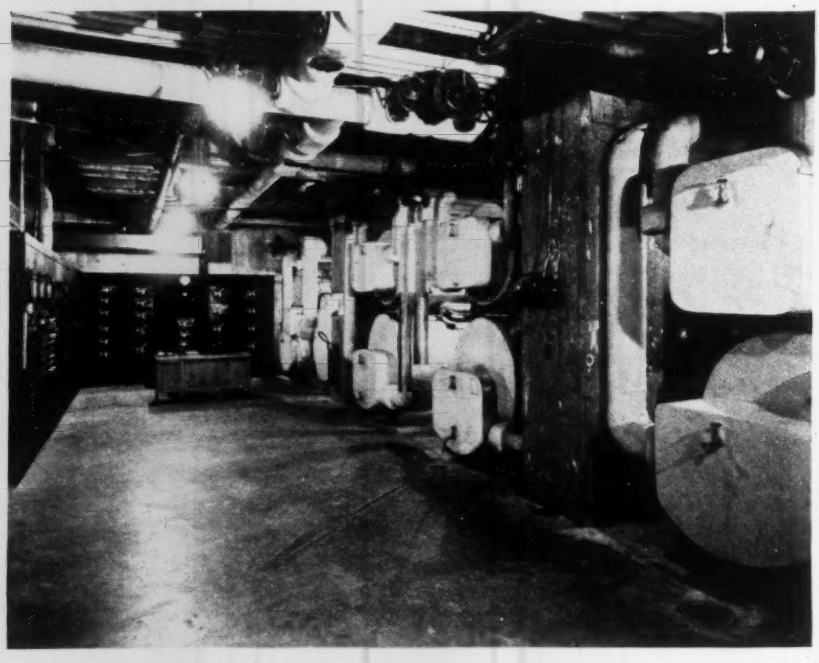

Fig. 2—Mechanical room, with the four heat pumps at right and the control and instrument panel at left

cooling to the air conditioning system is composed of four diffusion-type, centrifugal water-chilling machines, Fig. 2. Well water is the heat source. Wells not being pumped are used for disposal. The temperature control for air conditioning and the heat pump is somewhat more complicated than ordinary. A flow diagram applicable to the heating phase below 55 F outside temperature is presented as Fig. 3.

System Completed by Stages

The building was placed in use progressively as tenants were secured and spaces completed for them (see Table 1). The heat pump was placed in operation on January 9, 1948. For several months it was operated manually to supply the heat necessary for drying out plaster and to provide comfort for the few spaces which were at that time finished and in use in the building. By April 1948, automatic control for the heat pump had been placed in operation and recording of operating data was started. At that time the building was 48 percent occupied. There were still some areas of the building not closed to the outside. This was particularly true in the first floor area where shops and stores were later located. Also, in April of 1948 a preliminary adjustment of air volumes on the supply side only was accomplished. Final adjustments of air volumes were not completed until April 1949.

Actual Operating Methods

Operating methods varied in some respects from the usual. Following afternoon temperatures of 55 F or less, some heat pump capacity was

Table 1—Predicted and Actual Power Use
(Total for compressors and all pumps, in 100 kwhr)

Month	Predicted[a] 1940	Predicted[b], Adjusted to 1948-49	Actual 1948-49	Building Occupancy (Percent)
May	830	725	624	56
June	1033	1110	1080	62
July	1065	1060	993	74
Aug.	1253	1135	1080	89
Sept.	909	932	930	91
Oct.	705	730	809	92
Nov.	720	854	809	93
Dec.	720	1112	894	94
Jan.	814	1650	1640	95
Feb.	689	1098	1045	95
March	627	812	705	95
TOTALS	9365	11,218	10,609	

[a]Predicted use based upon Portland Weather Bureau Charts for 1940.
[b]Predicted values corrected for degree days and hours of operation, for 1948-49.

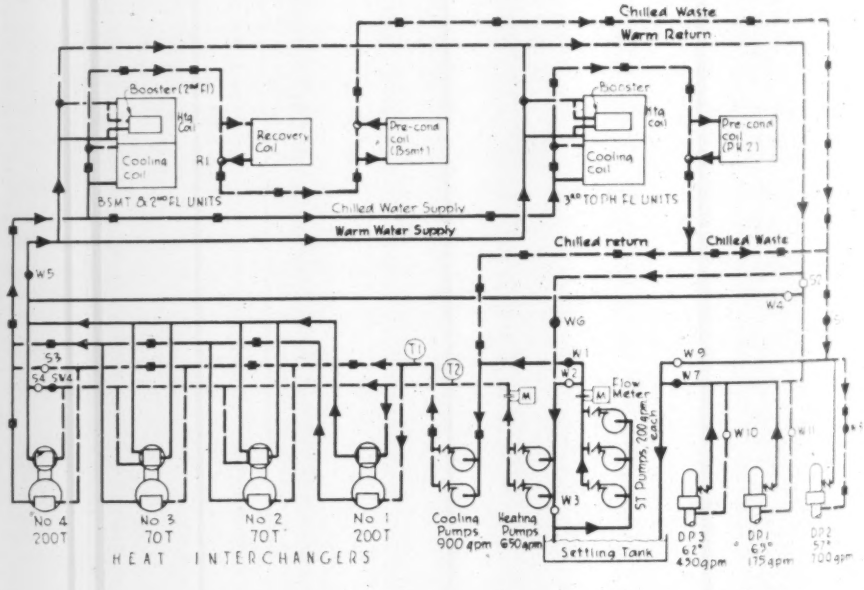

Fig. 3—Flow and control diagram (when heating is greater than cooling load)

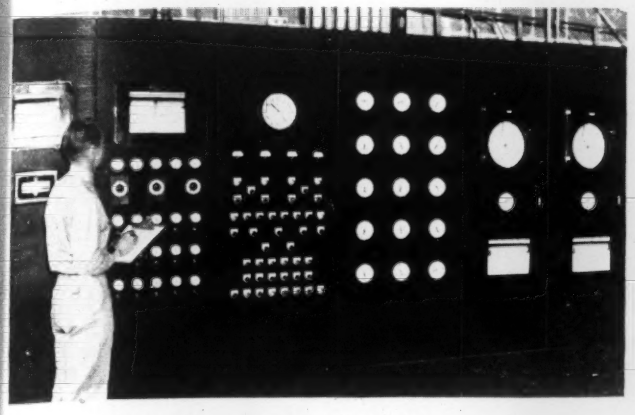

Fig. 4—Instrument and control panel

Showing room temperature recorders at left, pneumatic room thermostat adjusting switches and fan controls (in front of operator); main heat pump controls below clock; pressure and temperature gages; and flow meters

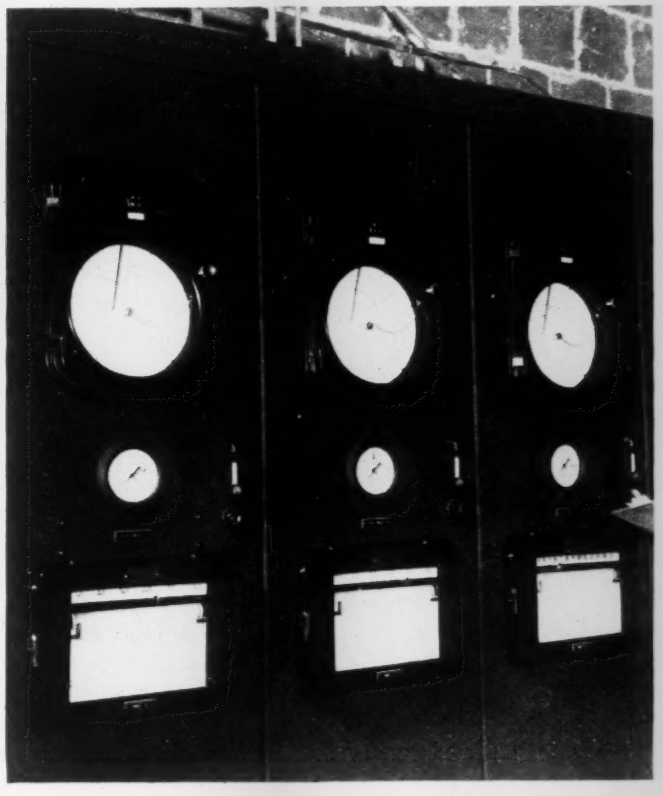

Fig. 5—Flow meters and water temperature recorders

Flow meters give record of water flows from settling tank and in heating and cooling circuits. Multipoint recorders provide data on water temperature

provided throughout the night to reduce the morning pick-up load. Reducing pick-up load has two advantages in this installation. *First*, the heat pump, being less efficient at high condenser temperatures, could be operated at better efficiency during the pick-up period. *Secondly*, the pick-up period was reduced, thereby avoiding creation of an electrical demand which would be superimposed on the normal building demand and result in a demand charge under the electric tariff applicable. The method of operation during cold weather was as follows:

During the night, starting at about 10:00 p.m. until about 6:00 a.m., either a single 70-ton machine, or, if the outside temperature was below 30 F, two 70-ton machines were placed on manual operation and allowed to run through the night. All outside air intake fans and exhaust fans, except for the toilet room group, were turned off. At approximately 6:00 a.m. all machines were placed on automatic operation and outside air again supplied. This continued until approximately 6:00 p.m., at which time the outside air supply was turned off. The machines remained on automatic operation until 10:00 p.m., at which time the cycle was repeated.

The amount of well water used as a heat source was considerably less than anticipated, and conditions during which exclusive interchange of heating and cooling prevailed extended over a greater period than expected. On days during which the average temperature was between 44 and 57 F and the diurnal range was relatively low (a condition typical of cloudy weather operation) well water was required by the heat pump system and automatically injected into it only during the morning pick-up period. Beyond this time period the heat losses and heat gains were sufficiently balanced to require no additional well water or, at most, very little well water. Since Portland's average winter temperature is 49.5 F and cloudiness is prevalent during the temperature range previously indicated, the days on which little or no well water was used account for a very material fraction of the heating season.

Instrumentation Applied

Detailed data on operation of the heat pump were obtained for the most part by recording instruments, Fig. 4. Pertinent data not recorded were read and entered on a daily log sheet.

Each of the three water circuits (heating, cooling, and well water) introduced into the system was provided with a recording-integrating flow meter, Fig. 5. Air temperature recorders, accurate to one-half degree, were provided for outside air and five space temperatures for each of three building floors. Water temperatures were recorded (1) at the combined supply to and discharge from condensers and evaporators; (2) at the discharge of each deep well; and (3) in well water introduced into the system, Fig. 5. Water temperature recorders were accurate to one-fifth degree. Indicating thermometers were used to check and verify recorded temperatures. From recorded data obtained on these instruments, heat output from the system and heat released within the building were computed.

A temporary panel, Fig. 6, contained electrical input and demand recorders for the water chilling units, two for deep well pumps, settling tank pumps, warm water circulating pumps, and chilled water circulating units. By means of these recorders, data were obtained to

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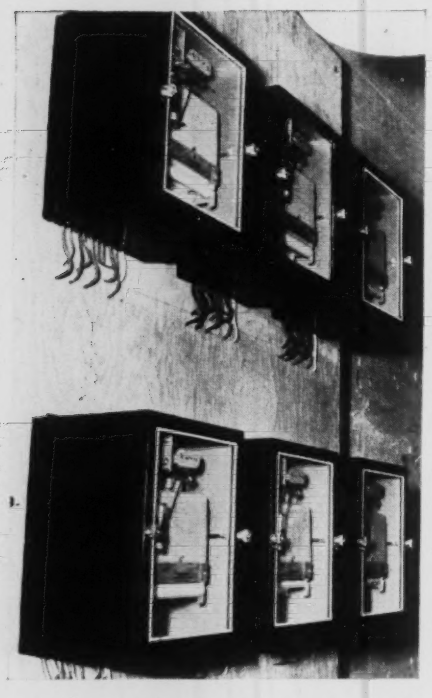

Fig. 6—Temporary watt-hour and demand meters

Record input data to heat pumps and collateral equipment

determine power input for the components of the heat pump system.

Conditions for which temperature data were not recorded continuously include: water entering the recovery coils; water entering the preconditioning coils; and water leaving the pre-conditioning coils. However, with air volumes and temperatures known and with data on water flow recorded, sufficient information was available to determine within reasonable limits the amount of heating accomplished by means of waste chilled water.

Basic Conditions Compared

Predicted power consumption and power costs were based on Weather Bureau data for the City of Portland for the calendar year 1940. This year was selected, because, during design, a consideration of the necessity for dehumidification required a detailed study in which hourly weather conditions, including dew point and dry bulb temperatures, were plotted for six months of the summer season. These studies showed 1940 as a critical year and provided much detailed data useful in cost analyses. The heating degree-days for 1940 were below normal. The winter of 1948-49, for which the operating data are available, was probably one of the most rigorous Oregon has experienced. While 1940 had 4100 degree-days, 4900 degree-days are reported for the 1948-49 winter and comparisons herein are based on these values.

The outside temperatures used in this study were Portland average daily temperatures. The days selected for study and computation of heat balances were days on which there was no sunshine. The loads shown are, therefore, somewhat higher than normal, since Portland's winter days, though predominantly cloudy, do have considerable sunshine.

The 24-hour average temperature method for determining heating requirements was considered proper because of the building lag involved in transmission of heat. An example is the transmission of heat from lights and other electrical input involved to the building materials, such as the ceiling or concrete floor slab, before it is transmitted to the air or affects the occupants of the building. Use of the 24-hour average temperature method takes into account and provides some allowance for the fact that steady state conditions are practically nonexistent.

Table 2—Actual Total Heat Input and Output for Selected Da
(24-hr average Mbh)

Item	Date	Average Temperature	Condenser Heat Output	Heat Input	
				Compressors Only	Compressors & Auxiliaries
1	Jan. 20	28	2240	566	623
2	Jan. 25	22	2510	623	715
3	Jan. 26	23	2500	623	702
4	Jan. 30	36	2000	453	510
5	Feb. 2	34	2220	510	554
6	Feb. 8	40	2030	398	418
7	Feb. 16	51	1570	283	306
8	Feb. 17	44	1658	398	442
9	Feb. 18	36	1930	453	500
10	Feb. 21	41	2020	458	479

[a] Deep well pumps and settling tank pumps.

Power Requirements Compared

A comparison of predicted and actual power requirements for the compressors or water chilling units and all pumps for eleven months of operation is shown in Table 1. To provide a proper basis of comparison, the predicted values, based on 1940 weather, have been adjusted to 1948-49 conditions and for differences in operating methods, as described. The latter was estimated as equivalent to three hours of daily additional operation for the colder weather. Power requirements were 5.3 percent less than adjusted predicted values. No adjustment has been made in the values for hours of operation in the months of May to October.

Heat Balances Established

The actual total energy input and output were computed for selected days from charts recorded as described, Table 2. Days selected for study were chosen from those having complete and unbroken records. The data are shown graphically in the heat balance curves of Fig. 7 and form the basis for establishing a general graphical comparison of heating requirements and loads. Insufficient study of all records and data was made to establish fully the heat input and output curves of Fig. 7. Some data for days having lower average temperatures were faulty, precluding more complete analyses. The heat input lines are shown as curves chiefly on the basis of lowered thermal efficiencies at the higher supply or condenser temperatures required at lower outside temperatures.

To arrive at a full heat balance, examination was made of all sources of heat in the building, including well water and motor equipment.

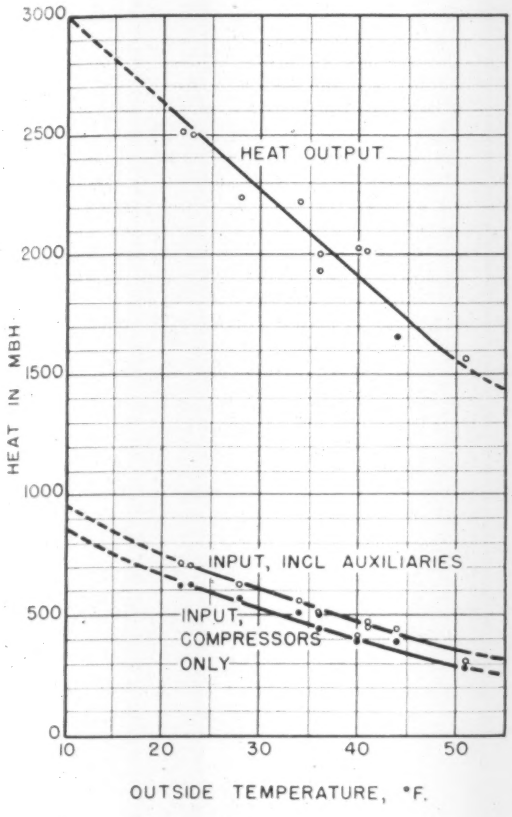

Fig. 7—Heat balance curves

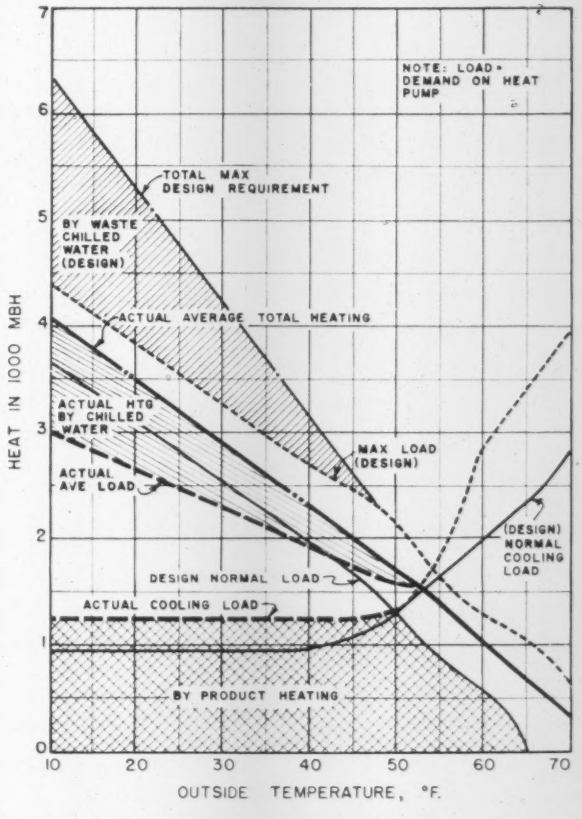

Fig. 8—Comparison of predicted and actual heat requirements and load

Typical tabulations for three days are shown in Table 3. Heat gain from occupants was taken at 33 percent of the sensible heat of actual occupants for business hours, inasmuch as the consideration is on a 24-hour basis to establish average values. Other heat gain values were obtained from measurements. Vagrant or unaccounted-for losses range between 12.5 and 14.5 percent of values for total heat released in the building at the temperatures given.

Table 3—Heat Balance for Selected Days
(24-hr average Mbh at average outside temperature)

Item	Consideration	Feb. 16 51 F	Feb. 21 41 F	Feb. 2 34 F
	Heat Released in Building			
1	Well Water	180	540	690
2	Compressor Motor	283	396	510
3	Pump Motors	80	100	140
4	Fan Motors	150	150	175
5	Bldg. Electrical Use	1020	1020	1020
6	Occupants	245	245	245
7	Recovery	25	275	300
8	Total Heat Released	1983	2726	3080
	Heat Supplied by System			
9	Pre-Conditioning Coils	125	350	475
10	Heat Pump	1570	2020	2220
11	Total Heat Supplied	1695	2370	2695
	Heat Balance			
12	Heat Released	1983	2726	3080
13	Heat Supplied	1695	2370	2695
14	Vagrant Loss	288	356	385

Detailed Comparison Made

The comparison of heating requirements and loads on the heat pumps predicted during design and actual conditions, as determined from the data and by means indicated, is shown in Fig. 8. Except that values for cooling are shown only as they affect heating, Fig. 8 consists of load curves presented in Fig. 1 of the previous paper[1], upon which are superimposed data on actual operating characteristics.

An important difference between predicted and actual heating curves shown is that the predicted curves were based on instantaneous values and the actual were based on 24-hour average conditions of temperature and load, as previously discussed. This accounts at least in

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some measure for the fact that the curve, *actual average load*, shows values of appreciably lower magnitudes. Similarly the amount of heat gained by recovery from exhaust ventilation air and use of waste chilled water to pre-heat or precondition incoming ventilation air is naturally of lower magnitude when considered on a 24-hour average basis.

The slope of the *actual average load* curve is less steep than that predicted. This may be due to mixing of air in the double plenum systems used primarily for control purposes, particularly when the outside temperature was in the vicinity of 50 F, when cooling and heating loads are approximately in balance.

The actual cooling load curve, representing by-product heat available, is higher than predicted. It is based on a study of the amount of electrical energy used throughout the building in applications other than air conditioning, as detailed for three conditions in Table 3.

Coefficients of Performance Revised

The previous paper[1] indicated a job coefficient of performance of 14.8 as fantastic under usual interpretation placed on the term. Under study of day-by-day average temperatures from May 1948 through March 1949, the integrated load between the area shown as *by-product heating* and the *actual average load* curve plus the heating accomplished with waste chilled water, when related to heat input, develops the even more fantastic coefficient of performance of 22.6 for compressors only, Table 4. Coefficients of performance on other bases are also shown in this tabulation.

The heat input for auxiliaries includes only the heat equivalent of power used by the deep well pumps and the settling tank pumps on the basis that a heat pump merely replaces the conventional heating means, such as a boiler, and thus power required by equipment inherent in the remainder of the system, or the heat distributing means, is not chargeable against the heat pump. Thus, the warm water and chilled water circulating pumps and the fan equipment are not considered auxiliaries in this paper.

Table 4—Coefficients of Performance

Item	Consideration	Compressors Only	Compressors & Auxiliaries[a]
1	As operated, with credit for by-product heat	22.6	19.2
2	As operated, without credit for by-product heat	5.6	4.8
3	Without credit for heat recovery and heating with waste chilled water	4.9	4.2

[a] Deep well pumps and settling tank pumps.

The coefficients of performance presented in Table 4 are another indication, previously suggested, that in any complex heating and cooling system a coefficient of performance is without meaning in the absence of detailed specification of division of load and means of application.

The justification for taking credit for by-product heating is the arrangement of the air conditioning system.

Outside air was not used for the internal or minimum cooling, since to do so would have required equipment arrangement on each floor, reducing the rentable space materially, and would have required even more complex automatic control. Thus mechanical cooling provides by-product heat and is considered properly credited to the heat pump. If use of steam for heating had been planned, with the heat pump adapted separately for cooling, the internal cooling, or the minimum cooling requirement shown in Fig. 8, would have been accomplished with outside air, reheated as required.

Costs Not Analyzed

As discussed in the previous paper[1], the electric utility's rate schedule applicable provides charges on both power consumption, and monthly maximum 30-min sustained electrical demands. Power consumption for each of the heat pump motorized elements and the total for the building were recorded, as were the demands for the heat pump units. However, the type of recording demand meter required for the building's electrical service was not available until quite recently. The weather has been mild since installation of the recording demand meter, so there has been no opportunity for records indicating whether the heat pump operation superimposes a demand which will be higher than the maximum building demand and thus be chargeable to the heat pump. Sufficient records are available to show that for outside temperatures ranging from 40 F upward, a uniform demand, higher than the building demand is created. Electrical demand of the heat pump for morning pick-up occurs at a time prior to building occupancy and is much smaller than normal building demand. It is quite possible, however, that heat pump electrical demands during colder weather will superimpose on building demands and create peaks higher than those of record. Since such demand is subject to a charge of $1.00 per kilowatt, the charge against heating may be material. Because such probable additional demand due to heat pump operation is not subject to accurate estimation, and since it may materially affect operation cost, although certainly not of the magnitude anticipated by the previous paper[1], no reliable data can be reported on heating cost at this time. However, from indications it is quite certain that the heating cost will be materially less than the $0.46 per million Btu originally estimated.

General Observations

Observation of a year's operation gives rise to comments which may be of interest and of some value in design or operation of a heat pump in a large building.

The heat source normally adapted will probably be well or surface water. Often such water is corrosive or may form accretive substances on metals. Water analyses should be made in all cases to de-

termine required treatment, if any. For example, two wells in the Equitable Building have water which is slightly acid and which contains appreciable amounts of iron and of carbon dioxide. Corrosion has resulted and iron bacteria have caused some problems. Both are now under simple but adequate treatment. Necessity of treatment should be determined prior to application of design, since in some cases the cost thereof may be so high as to render application of a heat pump uneconomical.

One of the primary causes of corrosion from well water is the oxygen contained in the water as it is introduced into the system. Even with water which otherwise might be considered good water corrosion will result if the water is aerated to any degree. Therefore, provision should be made to limit to a minimum the amount of air picked up by the water. This requires a type of settling tank which does not present a large surface of water exposed to air. It also requires constant pumping of the well, with modulation of volume obtained by the use of valves.

The feasibility of heat recovery with the heat pump systems due to the quantities of water and air being handled is definitely substantiated by experience of operation on the Equitable Building, as is the economy of using the waste water for pre-conditioning incoming ventilation air.

The importance of applying the best possible automatic control in the interest of operating economy cannot be over-emphasized. Because it is necessary to use small temperature differentials in the supply and return water and in the supply air, the control must be accurate and it must be flexible. Flexibility is required in order to maintain the most efficient conditions of operation for the refrigeration equipment. For example, while a coefficient of performance of 5 or 6 may be obtained on a basic refrigeration cycle with a condensing temperature of about 80 to 85 F, the coefficient may drop to as low as 3 when this temperature is raised to 105 or 110 F. The major capacity control instruments in any heat pump installation of over 200 tons capacity should be of the industrial type, with automatic reset within the instrument, if the method of control requires it.

In providing for the automatic change of water circuits from one type of operation to another, care must be exercised in arranging the opening and closing of valves in sequence to prevent damage from water shock or hammer.

Control devices should be located in a central mechanical room with the primary heat pump equipment and sufficient recording instruments of various types should be installed. Such instruments include flow meters, temperature recorders, room temperature and humidity recorders, together with units to control the outside air fans, exhaust fans, etc. With assistance of this nature, an intelligent operator can hold the air conditioning costs to a minimum, observe operation of his equipment, and know the comfort conditions in the building with very little additional manual help.

The operator himself should be above the average operating personnel. He must have an analytical mind which can sort out and properly correlate the information which the recorders give. An intelligent operator properly trained can save $150 to $200 a month in operating costs alone in a system the size of that in the Equitable Building.

Finally, observation of the Equitable Building heat pump application has indicated that the carefully detailed studies of loads and methods, including several innovations, have paid dividends in economy of operation.

DEGLER SPEAKS AT CONFERENCE

Among the speakers appearing at the Wisconsin Power Conference held in Milwaukee June 2-4, 1949, was Howard E. Degler, who spoke on water supply.

Mr. Degler, Technical Director, The Marley Company, Kansas City, Mo., presented information concerning the present problem of water waste, conservation and re-use. Other topics discussed at the Conference by various speakers included: Boiler Design Requirements; Industrial Insulation; and Bituminous Coal.

A panel discussion on air pollution covered the subjects of fly ash, turbulence and combustion.

John R. Allen Memorial Library

The ASHVE Committee on Research gratefully acknowledges the following gifts to the John R. Allen Memorial Library, which is maintained at the Society's Research Laboratory, 7218 Euclid Ave., Cleveland 3, Ohio.

Heating and Ventilating, by Oscar Faber (1949). Gift of the author.

Temperature and Human Life, by C.-E. A. Winslow and L. P. Herrington (1949). Gift of the authors.

The presentation of textbooks and pamphlets in the field of heating, ventilating, and air conditioning and allied fields, by authors and others, will be welcomed by this library. Suitable book plates carry the name of the donor and date of the gift.

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Determining Performance of a Blower Used with a Furnace

By N. A. Buckley* and R. W. Roose,** Urbana, Ill.

SUMMARY—A blower installed in conjunction with a forced warm-air furnace operates against the predetermined resistance of the external duct system and the unknown internal resistances of the blower-furnace combination. The internal resistances or pressure drops can be determined by establishing the difference between the performance of the blower operated separately, and the performance of the blower when operated in conjunction with a furnace.

The authors describe a test arrangement and a procedure which make it possible to determine the performance of blowers used in conjunction with various forced warm-air furnaces having a maximum output of 150,000 Btu per hour.

In a typical forced-warm-air heating system, air is drawn through the return-air ducts and into the furnace through air filters, and is then forced over the heat exchanger surfaces and through the warm air duct system into the space to be heated as shown in Fig. 1. The force required to move the air through this system of ducts and restricted passages is developed by a furnace blower installed inside the casing of the furnace, or in a blower cabinet in close proximity to the furnace.

The resistances placed on the blower by the duct system, external to the blower-furnace combination, are usually predetermined at some arbitrary value by the designer of the duct system. However, the internal resistances of the furnace and blower cabinet can not be predetermined or calculated in advance and must be evaluated by actual tests.

Object and Scope of Investigation. The object of this investigation was to specify a test arrangement and method which would enable blower and furnace manufacturers to determine the performance characteristics of a blower† when used in conjunction with a forced-air furnace.

Methods of Determining the Performance of a Furnace Blower. At the time that this project was originated no convenient test method had been formulated to determine the performance of a blower when used in conjunction with a furnace. However, several methods are available for obtaining the performance of a furnace blower alone. Among these, the two most commonly used and accepted are the methods designated as Plates I and V by the *National Association of Fan Manufacturers* as shown in Fig. 2, hereafter abbreviated to *NAFM* Plates I and V methods.[1]

The *NAFM* recommends that the Plate V method be used in testing and rating furnace blowers, but because of the extensive space and equipment necessary for using the Plate V method, few manufacturers have adopted it. At the present time, furnace blowers are usually tested and rated by the Plate I method. It is recognized that the performance of a furnace blower as obtained by the Plate I method may deviate somewhat from that obtained by the Plate V method, and furthermore, may not be truly representative of the performance of a blower used with a furnace.

* Special Research Assistant, University of Illinois. Junior Member of ASHVE.

** Special Research Associate, University of Illinois. Junior Member of ASHVE.

Presented at the Semi-Annual Meeting of the American Society of Heating and Ventilating Engineers, Minneapolis, Minn., June 1949.

† The term *blower* as used herein refers to a centrifugal fan. The warm-air heating industry uses the term blower to distinguish centrifugal fans, such as are now used in forced air systems, from propeller fans which were originally used.

[1] Exponent numerals refer to References.

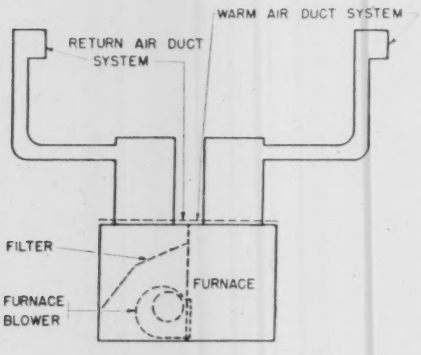

Fig. 1—Schematic diagram of a forced air heating system

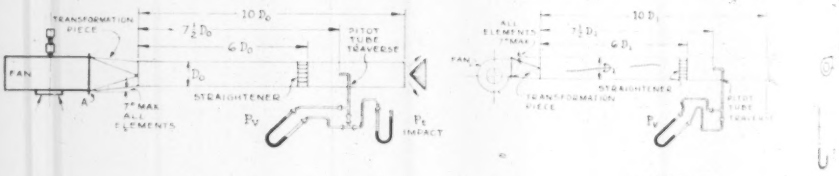

PLATE I

Blowers—Single or Double Inlet

Duct: **Total pressure, p_t, by impact tube—Velocity pressure, p_v; Differential reading between impact tube and static tube.**

Fan Outlet: **P_v; Correct p_v to P_v, the velocity pressure corresponding to fan outlet area, A—P_t; Add to p_t the calculated duct friction and straightener loss—P_s; Subtract P_v from P_t—Correct all pressures to standard air conditions. All additions and subtractions mentioned above are arithmetical. No inlet pressure readings are to be taken and no alteration of designed inlet is to be made.**

PLATE V

Blowers and Exhausters without Duct

Supply Duct: **Velocity pressure, p_v; Differential reading between impact tube and static tube.**

Chamber: **p by impact tube.**

Fan Outlet: **P_v; Correct p_v to P_v, the velocity pressure corresponding to fan outlet area, A—P_t; Add p to P_v—P_s; Subtract P_v from P—Correct all pressures to standard air conditions. All additions and subtractions mentioned above are arithmetical. Refer to Plate XII for chamber proportions.**

Fig. 2—Two methods of testing and rating furnace blowers

The performance obtained by the Plate I method is dependent to some extent upon the area of the blower discharge and the conversion of velocity pressure to static pressure in the test duct, whereas in an actual installation, a considerable portion of the velocity pressure may not be regained.

However, since the Plate I method is predominantly used at the present time in rating furnace blowers, it was used in the tests reported in this paper to illustrate the procedure for determining the pressure drop through the blower-furnace combination. The procedure given is applicable to either the Plate I or the Plate V method, and any later adoption of the Plate V method by the furnace blower industry will not invalidate the conclusions of the paper.

The performance of the blower, regardless of the method used to obtain it, can be represented by a curve in which the air quantity in cubic feet per minute is plotted against static pressure. For any given speed, the blower will deliver an amount of air dependent upon the resistance opposed to flow.

Variables Involved in Determining the Performance of a Blower-Furnace Combination. The combination of a blower and furnace can be considered as an equivalent blower unit. As in the case of an isolated blower the performance of the combination can be represented, for a particular blower speed, by plotting the algebraic difference between inlet and discharge pressure obtained by piezometer connection against air quantity flowing. This blower speed corresponds to that required to obtain the performance recommended by the *National Warm Air Heating and Air Conditioning Association* in *Manuals* 6[5] and 7[3].

These operating conditions can be summarized as follows: with rated fuel input to the furnace, the combination must be able to provide a static pressure of 0.20 in. of water external to the unit and maintain a temperature rise of 100 deg through the unit from inlet to discharge. When the combination is operated with these limiting conditions, a specific blower speed can be established. The performance of the combination for this given blower speed can be determined by varying the static pressure external to the unit and finding the corresponding quantity of air.

Description of Test Apparatus

Hi-Boy[4] Furnace Test Arrangement. The test arrangement for the hi-boy furnace consisted of an orifice box, a trunk duct, the furnace, and a furnace plenum together with stub duct. A schematic diagram of the test arrangement is shown in Fig. 3. The orifice box, 5 ft wide by 5 ft deep by 4 ft high, was provided with: an auxiliary blower and a ¾ hp driving motor inside the box; four orifices, 5, 7, 8, and 11 in. in diameter on top; and a piezometer connection at the center of the top plate.

The trunk duct attached to the orifice box at the auxiliary blower discharge was 24 in. × 30 in. and contained a slide damper, a perforated plate, and egg-crate straighteners. A piezometer ring was installed at the measuring station for determining the static pressure in the trunk duct.

A plenum 6 ft high was installed at the furnace discharge and was covered with two layers of ¼ in. corrugated asbestos insulation, to minimize heat loss from the plenum between the furnace discharge and the temperature measuring station.

Lo-Boy[6] Furnace Test Arrangement. The test arrangement for the lo-boy furnace consisting of the orifice box, trunk duct, the lo-boy furnace, the furnace plenum, and stub duct is shown schematically in Fig. 4.

The trunk duct in this arrangement formed an arch to allow entry of the air at the top of the fan compartment. The plenum height was the same as that shown in Fig. 3 but the areas of the plenum and the stub duct were larger to correspond with greater furnace capacity.

Instrumentation. The differential pressures of the orifice box, the static pressures in the trunk duct, and the static pressures in the plenum were measured by means of inclined draft gages. Two gages with scale markings from 0 to 0.5 in. of water and two gages with scale markings from 0 to 1.0 in. of water were used. These draft gages were each calibrated with a sensitive micromanometer and correction curves were established. The speed of the furnace blower was observed by means of a speed indicator, reading directly in revolutions per minute.

Thermocouples located at the inlet and discharge of the furnace

[4] Designation of a furnace unit having a fan located below the heating element.

[6] Designation of furnace with fan located at side of heating element.

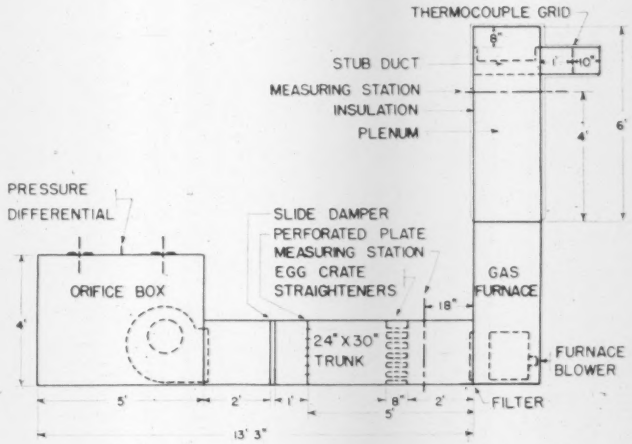

Fig. 3—Schematic diagram of the hi-boy furnace test arrangement

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were used to measure air temperatures. Wet and dry bulb temperatures of the inlet air were obtained by means of a sling psychrometer. A gas meter and stop watch were used to determine the actual gas input volume delivered to the furnace, in cubic feet per hour. At the inlet to the gas meter gas temperature was read with a thermometer and gas pressure was measured by a vertical draft gage. Barometric pressures, used for correcting data to standard conditions, were obtained by means of a mercury barometer.

Description of Equipment Tested

The Hi-Boy Furnace. The hi-boy furnace was tested with three different blowers, referred to as blowers A, B, and C. The rated capacity of the furnace was 58,000 Btu per hour output with an input of 72,500 Btu per hour. The fuel used was natural gas which was burned in a single port, blue flame tubular burner. As is conventional for hi-boy units, the blower was mounted below the heat exchanger, and the air was discharged upward against the bottom of the fire box.

The heat exchanger was of welded steel construction with four tubes slanting diagonally through it from the center of the front and discharging at the top near the rear of the furnace. The clearances between the radiation jacket and heat exchanger were approximately 1 in. At the discharge of the furnace, the radiation jacket was bent inward to cause the air to pass over a greater amount of heat exchanger surface and to place resistance to the flow of air around the heat exchanger, thereby causing more air to pass through the four heat exchanger tubes.

Two return-air inlets were located on opposite sides at the base of the furnace. One or both inlets could be used in operating the unit although for the present tests only one inlet was used. The filter was installed in the return-air inlet.

Blowers A, B, and C. The three 9-in. blowers tested with the hi-boy furnace were centrifugal upward discharge blowers having forward curved blades. Blowers A and B were the blowers normally installed in the furnace when sold commercially. Blower C, although of the same general type, was specially built for this investigation.

The Lo-Boy Furnace and Blower D. The rated capacity of the lo-boy furnace was 132,000 Btu per hour output with an input of 165,000 Btu per hour. The fuel used was natural gas which was burned in a ribbon-type burner.

A blower of the bottom horizontal discharge arrangement was installed in a cabinet integral to the furnace. The blower discharged into a chamber below the heat exchanger, and against the back of the fire box. The air then passed through the flat-tube heat exchanger and out through the top of the furnace. Filters of the throw-away type were located above the blower, and the return-air inlet was above the filters.

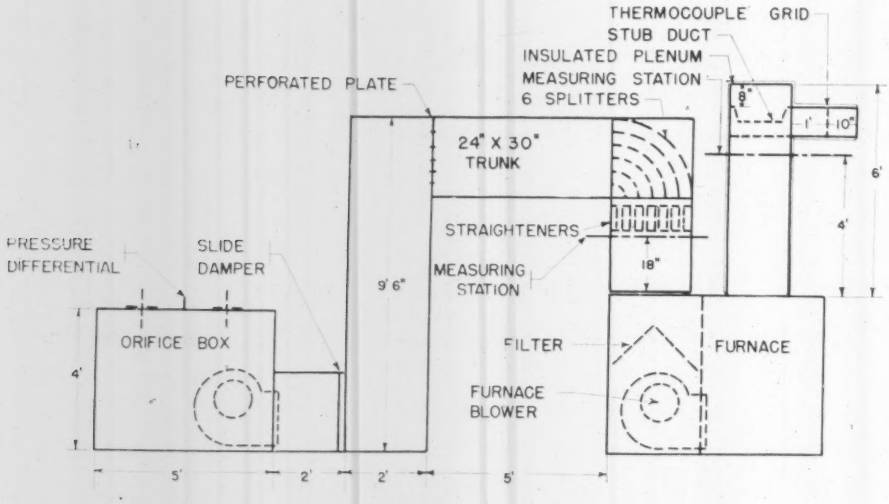

Fig. 4—Schematic diagram of the lo-boy furnace test arrangement

Development of Procedure

Effect of Placement of External Resistance and Temperature Rise on Performance. A large number of preliminary tests were conducted to determine the effect on performance of changes in the adjustment of various parts of the test arrangement. Four series of tests were conducted to determine the effect of separately applying the external resistance on the inlet and discharge sides of the combination, and running tests with the furnace both hot and cold. These preliminary tests consisted of the following series:

1. With no heat input and with external static resistance applied at the furnace inlet.
2. With no heat input and with external static resistance applied at the furnace discharge.
3. With rated heat input and with external static resistance applied at the furnace inlet.
4. With rated heat input and with external static resistance applied at the furnace discharge.

The hi-boy furnace was tested in combination with blower A and the data were plotted as shown in Fig. 5. These tests were conducted both with the filters installed in the unit and with the filters removed.

On May 20, 1947, two series of tests were conducted, one with resistance on the inlet and the other with resistance on the discharge. The points representing these two series of tests could be plotted on a single curve as shown by curve IV in Fig. 5. Apparently, the placement of resistance on both the inlet and discharge of the blower-furnace combination gave the same performance.

On August 18, 1947 two series of tests were conducted under similar conditions and these data are rep-

resented by Curve V in Fig. 5. Again, the placement of resistance at both the inlet and discharge gave the same performance; however, in this case the performance curves were lower than those for the tests conducted three months earlier. This difference was attributed to the filling of the filter with dust and lint, resulting in an increase in pressure drop through the filter.

Steel plates provided with a large number of ¾ in. holes were therefore substituted for filters. This arrangement eliminated any change in pressure drop such as would be caused by accumulation of dirt in a filter.

The effect of adding heat to the unit is shown by the two performance curves II and III in Fig. 5 which were established with the filters removed and with rated fuel input to the furnace. The addition of heat to the unit resulted in a decrease of static pressure available external to the unit for the same blower speed and quantity of air handled. This decrease in performance is illustrated by the difference between the pressure drop curves in Fig. 6. Assuming the Plate I performance to be a true indication of the performance of a furnace blower when operated separately, the difference between the Plate I performance curve and that for the blower-furnace combination can be considered as the pressure drop through the blower-furnace combination. Pressure drop Curve (I-II) of Fig. 6 was higher than Curve (I-III) which indicates that the pressure drop through the blower-furnace combination was increased slightly when heat was added.

These results were predicted by S. H. Downs[4] who stated that in a system so arranged that heat is added or subtracted, heat change is coincidental with the resistance, or

$$r = K_1 \cdot \frac{T_m}{T_1}$$

where

$$T_m = \frac{T_2 - T_1}{\log_e \frac{T_2}{T_1}}$$

or

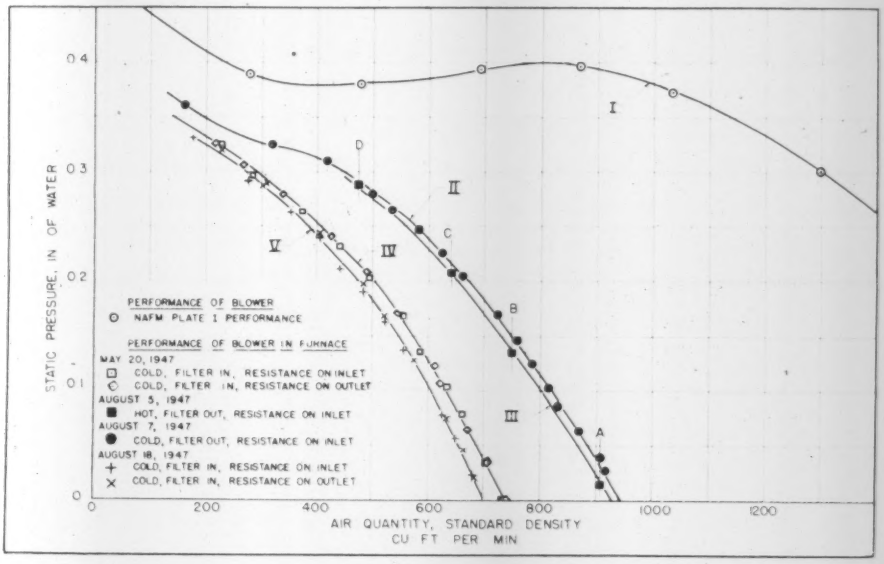

Fig. 5—Performance showing effect of placement of resistance and addition of heat

$$r = K_2 \cdot \sqrt{\frac{T_2}{T_1}} \text{ (approx.)}$$

where

r = system static resistance, inches of water
K_1 = a constant
K_2 = a constant
T_1 = temperature entering the system, degree Rankine
T_2 = temperature leaving the system, degree Rankine
T_m = log mean temperature, degree Rankine

It was also stated by Downs in another paper,[5] that a determination of resistance as affected by temperature changes can be made by the proportionalities:

$$\frac{R_H}{R_c} = \frac{T_m}{T_1}$$

or

$$\frac{R_H}{R_c} = \sqrt{\frac{T_2}{T_1}} \text{ (approx.)}$$

where

R_c = static resistance of system when no heat is added, inches of water
R_H = static resistance of system when heat is added, inches of water

Calculations of the temperature ratios $\frac{T_m}{T_1}$ and $\sqrt{\frac{T_2}{T_1}}$ were made at the four points indicated in Figs. 5 and 6 as A, B, C, and D, and the results were tabulated in columns 10 and 11 of Table 1. These calculated values were within 1 percent of the ratio $\frac{R_H}{R_c}$ obtained from test data, which is within the accuracy of the instruments used.

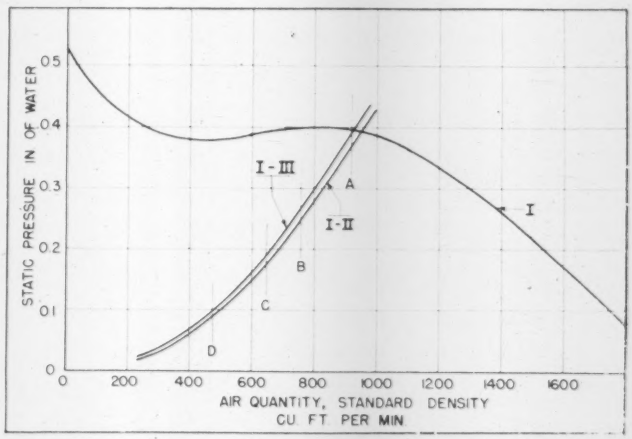

Fig. 6—Pressure drop curves showing effect of addition of heat

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The excellent agreement between the actual resistance ratio and calculated temperature ratios indicated that, at least for the given furnace, the procedure for determining the resistance of a furnace when heat is added could be simplified. Some question arose as to the temperatures that should be assumed for the correction ratio. In this connection it should be recognized that the range of possible temperature rises through a furnace is limited to a maximum range of 70 to 100 F. Hence, as shown in column 10 of Table 1, for test points C and D which have temperature rise values of 77.9 and 101.4 respectively, the correction ratio of T_m/T_1 is limited to ratios between about 1.07 and 1.09. For practical purposes, therefore, an average value of 1.08 for this temperature correction ratio was selected and used in subsequent corrections.

Comparison of Performance of Blowers A, B, and C Operated in Combination With the Hi-Boy Furnace. Three blowers were tested in combination with the hi-boy furnace. First, performance curves were established by determining a definite blower speed. This was accomplished by operating the furnace with a 100 deg temperature rise at rated fuel input and with 0.20 in. of water static resistance applied externally to the blower-furnace combination. The unit was then operated with no heat input. By varying the static resistance external to the combination, a performance curve for the combination was established. Finally, the blower was removed from the furnace and an *NAFM* Plate I performance curve was determined. All data were corrected to standard conditions and to the speed (rpm) determined at rated conditions. These data are shown in Fig. 7.

Comparison of data from the tests with the three blowers indicated that rated operation occurred at the same point for all three blower-furnace combinations. The performances of the blowers when used in combination with the furnace were approximately the same over the range of air quantities obtained for a 70 to 100 deg temperature rise.

Although the performances of the furnace-blower combinations were approximately the same, the Plate I performance curves for these blowers were quite different. The pressure drop through the furnace, obtained by the difference between the Plate I performance

Table 1—Relationship Between Absolute Temperature and Pressure Drop Through a Furnace

(1) Conditions	(2) cfm	(3) T_1	(4) T_2	(5) $T_2 - T_1$	(6) T_m	(7) R_H	(8) R_C	(9) $\frac{R_H}{R_C}$	(10) $\frac{T_m}{T_1}$	(11) $\sqrt{\frac{T}{T}}$
A	910	549.5	607.6	58.1	581	0.378	0.359	1.053	1.057	1.028
B	750	548.5	616.0	67.5	587	0.262	0.246	1.064	1.069	1.034
C	640	547.5	625.4	77.9	589	0.183	0.171	1.070	1.075	1.037
D	475	546.1	648.1	101.4	596	0.093	0.081	1.082	1.089	1.043

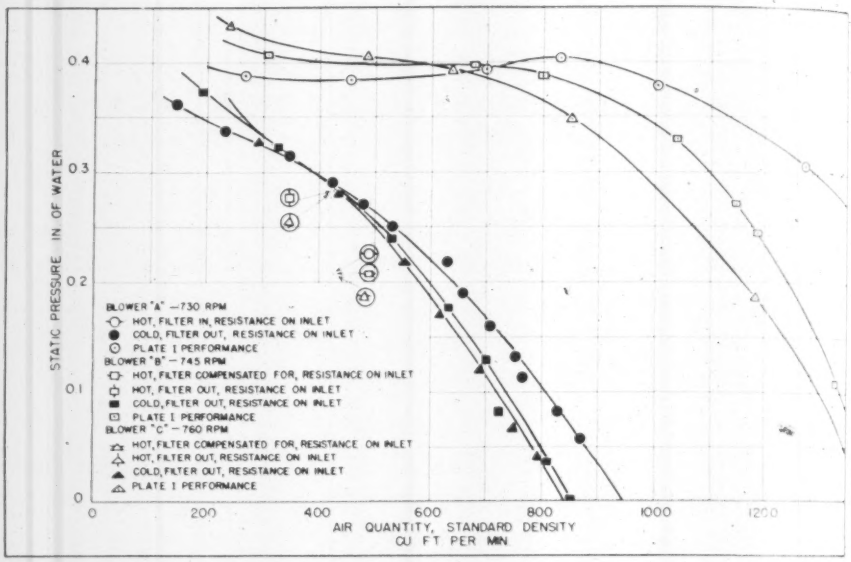

Fig. 7—Performance curves for blowers A, B, and C

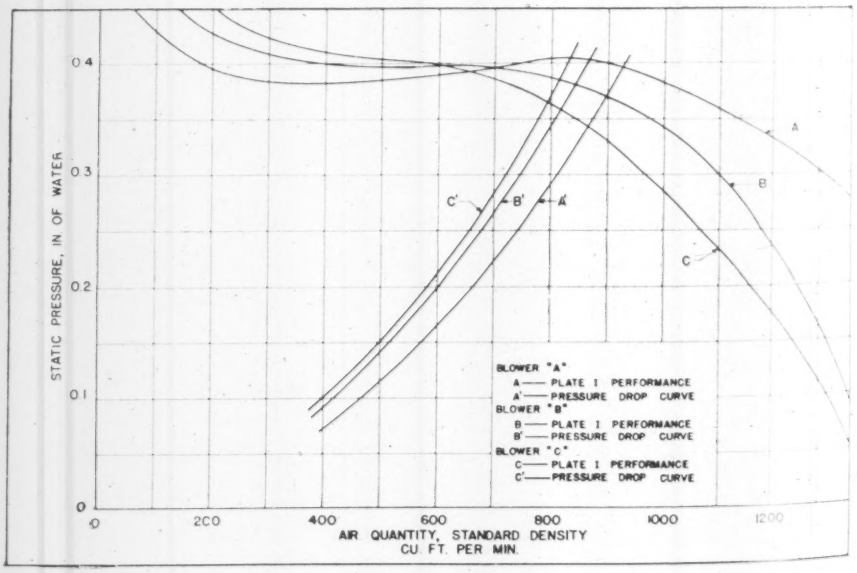

Fig. 8—Pressure drop curves for blowers A, B, and C

curve and the corresponding performance curve of the blower-furnace combination, was also plotted (Fig. 8).

The difference in pressure drop curves for the three blowers cannot be attributed to any change in the system. Therefore, it may be concluded that blowers of the same type and nominal size, but produced by different manufacturers, do not necessarily perform identically when installed in the same furnace. In another series of tests conducted with a lo-boy furnace, curves similar to those shown in Fig. 8 were obtained.

Conclusions

1. A test arrangement and method have been developed, which provide for rapid determination of the performance of a blower-furnace combination, and which give an accuracy well within the requirements of industrial applications.

2. The internal resistance of a furnace cannot be calculated. Therefore, the *NAFM* Plate I or Plate V performance of a blower cannot be reduced by the amount of internal resistance of a furnace in order to determine the performance of a blower-furnace combination.

3. Blowers of the same type and nominal size, but produced by different manufacturers, do not necessarily perform identically when operated with the same furnace.

4. It is advisable to use a substitute for the furnace filters when conducting furnace performance tests. A set of filter substitute plates have been developed for this purpose.

5. Variable resistances can be applied on either the inlet or the discharge of the furnace without changing the performance characteristics of the furnace-blower combination.

6. Increase of resistance due to heating of the air by the furnace can be calculated. Over the narrow range of temperature rises encountered in furnace testing the pressure drop through a blower-furnace combination will be 8 percent greater when operated with heat input than when operated with no heat added. Pressure drop with heat added = (Pressure drop with no heat added) × 1.08. Therefore, except for establishing rated operating conditions, conducting tests with heat added is not considered essential.

Recommended Procedure

Establishing the Rated Point of Operation. Based upon the experience gained in conducting the tests on both the hi-boy and lo-boy blower-furnace combinations, a general procedure has been developed. The blower-furnace combination to be tested is installed in the arrangement shown in either Fig. 3 or 4, depending on the type of furnace to be tested. Since the method is the same for both arrangements, the procedure will be

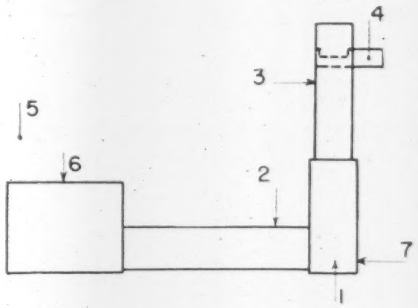

Fig. 9—Schematic diagram of test arrangement

outlined for the hi-boy arrangement alone. The seven measuring stations designated in Fig. 9 will be referred to by number in the steps outlining the procedure. The rated point of operation is determined by varying the blower speed until a 100 deg temperature rise is obtained with rated fuel input and a static resistance of 0.20 in. of water applied externally to the unit. The procedure for establishing the rated point of operation may be outlined as follows:

1. Supply the rated fuel input to the furnace, as designated by *1* in Fig. 9.

2. Start both the auxiliary blower in the orifice box and the blower under test. Apply an external static resistance of 0.20 in. of water to the blower-furnace combination by varying the closure of the trunk slide damper. The algebraic difference in static pressures as measured at stations *2* and *3* gives the external static resistance.

3. Determine the temperature rise through the unit by the difference in temperatures at *4* and *5*.

If the temperature rise through the furnace exceeds 100 deg, an insufficient quantity of air is being delivered through the furnace. In order to increase the quantity of air flowing, and thus decrease the temperature rise when 0.20 in. of water static resistance is being applied externally to the combination, the speed of the blower should be increased and steps 2 and 3 should be repeated. However, if the temperature rise through the furnace is too small, the quantity of air being delivered through the furnace is too great. In order to decrease the quantity of air delivered through the furnace, the speed of the blower is decreased; steps 2 and 3 are then repeated to determine the new temperature rise. When a 100 deg temperature rise has been attained, the rated point of operation and rated blower speed have been established, and steps 4 and 5 can then be carried out.

4. Obtain the quantity of air being delivered to the furnace, for rated operation, from the orifice differential at *6*.

5. Obtain the blower speed for rated operation of the blower-furnace combination at *7*.

After correcting the data obtained in steps 1 through 5 to standard conditions, the rated point of operation can be plotted as shown by point B in Fig. 10*a*.

Establishing the Performance Curve. Once the rated point of operation has been established, the ratio between the pulley speeds on the blower and on the blower motor should be held constant, but the fuel supply to the furnace should be shut off. No heat should be added to the furnace for any of the remaining tests.

A performance curve for the blower-furnace combination under test should be determined in the following sequence:

1. Adjust the trunk slide damper to the closed position, thus applying the maximum amount of resistance externally to the blower-furnace combination.

2. Start the blower which is being tested with the furnace, but not the auxiliary blower in the orifice box. With these operating conditions the following data can be obtained:

a. The quantity of air being delivered to the furnace, by means of the orifice differential at *6*.

b. The static resistance applied externally to the blower-furnace combination, by the algebraic difference in static pressure at *2* and *3*, and

c. The speed at which the blower is operating at *7*.

3. Change the closure of the trunk slide damper and repeat step 2, obtaining the quantity of air flowing, static resistances external to the unit, and the blower speed.

4. Having obtained the full range of values available for only the furnace blower in operation, start the auxiliary blower in the orifice box and obtain the full range of values available with both the furnace blower and auxiliary blower operating as outlined in steps 1 through 3.

5. Correct the data obtained in steps 1 through 4 to standard conditions for air and the blower speed established

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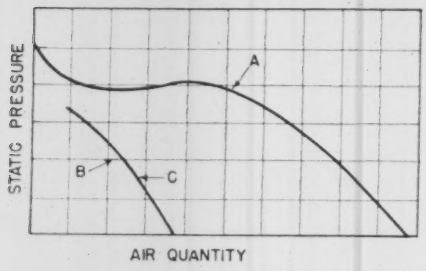

Fig. 10*a*—Performance curves

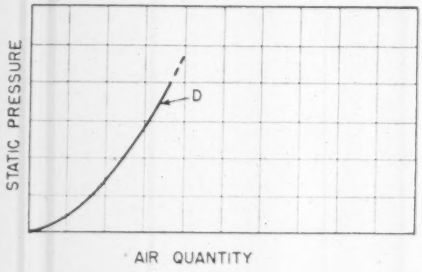

Fig. 10*b*—Pressure drop curve

for rated operation. The data when plotted will be similar to the typical performance curve shown on Curve C in Fig. 10*a*.

Pressure Drop through the Unit. The drop in static pressure occurring as the air passes through the blower-furnace combination is determined by the difference between the performance of the blower installed in the furnace, and the performance of the blower when operated separately. The method of procedure for obtaining the performance of a blower installed in a furnace is outlined in the previous section of this paper, and a representative plot is shown as Curve C in Fig. 10*a*. A representative Plate I performance curve is shown as Curve A in Fig. 10*a*. The difference between the performance of the blower installed in a furnace (Curve C) and the performance of the blower operated separately (Curve A) is shown as Curve D of Fig. 10*b*.

Acknowledgments

The results presented in this paper were obtained in connection with an investigation of warm-air heating systems being conducted in the Department of Mechanical Engineering at the University of Illinois. This investigation is a part of the cooperative project jointly sponsored by the Engineering Experiment Station of the University of Illinois and the *National Warm Air Heating and Air Conditioning Association*.

Acknowledgment is made to Professor S. Konzo for his invaluable assistance in outlining the test objectives and in analyzing the test results. These results will ultimately comprise part of a bulletin of the University of Illinois Engineering Experiment Station.

Acknowledgment is made to the *Furnace Blower Manufacturers Association* for supplying valuable technical assistance and to the various manufacturers who cooperated by furnishing materials and equipment.

References

1. Standard Test Code for Centrifugal and Axial Fans, 3rd Edition. (*National Association of Fan Manufacturers*, Detroit, Mich., 1941.)

2. *Manual 6*, Service Manual for Continuous Air Circulation Technicians, 1st Edition. (*National Warm Air Heating and Air Conditioning Association*, Cleveland 14, Ohio, 1947.)

3. *Manual 7*, Code and Manual for the Design of Warm Air Winter Air Conditioning Systems, 2nd Edition. (*National Warm Air Heating and Air Conditioning Association*, Cleveland 14, Ohio, 1947.)

4. System Characteristics, by S. H. Downs. (Clarage Fan Co., Kalamazoo, Mich., 1933.)

5. Varying Densities Within a System and Effect on Ratio of Opening, by S. H. Downs. (Clarage Fan Co., Kalamazoo, Mich., 1933.)

LOUCKS ELECTED PRESIDENT AT *NDHA* ANNUAL MEETING

David W. Loucks, Pittsburgh, was elected president of the *National District Heating Association* during the 40th Annual Meeting of the *NDHA* held May 24-27, 1949 at Swampscott, Mass.

George H. Tuttle, Detroit, Mich., became 1st Vice President and Robert D. Martin, New York City, was elected to serve on the Board of Directors. John F. Collins, Jr., Pittsburgh, Pa., was re-elected Secretary-Treasurer. Retiring president is Henry L. Martin, Boston, Mass. All are members of ASHVE.

Other officers of the *NDHA* are: 2nd Vice President—Alfred T. Veness, Rochester, N. Y.; 3rd Vice President—Percy A. Hyde, Akron, Ohio; Directors—F. Lee Rapson, Baltimore, Md., and Harold W. Coombs, Cambridge, Mass.

During the first session on Tuesday, May 24, Mr. Martin gave the president's annual address. Reports were made by Mr. Collins, Leonard S. Phillips, New York City, J. Earl Seiter, Baltimore, Md., Ernest T. Smith, Detroit, Mich., and John F. Malone, Baltimore.

Mr. Loucks presided over the afternoon session on Tuesday during which a panel discussion and a technical paper were presented. F. S. Pherigo, Indianapolis, took part in the panel discussion on heating problems in the planning of buildings. Walter A. Schulmeister, N. Tonawanda, N. Y., presented a paper on *Package Type Steam Water Heaters*.

The morning session of May 25 included the following speakers: Sterling S. Sanford, Detroit—*New Business 1948;* O. Eldridge Gammill, Jr., Syracuse, N. Y.—*Cooling with Heat;* discussion of Mr. Gammill's paper by Walter F. Friend, New York; and the presentation by Clifford Strock, New York, of a paper by Brother Borromeo, C.S.C., Notre Dame, Ind., on *Control of Steam Load at Notre Dame University*.

A report on research was given by Arthur S. Griswold, Chairman of the *NDHA* research committee. Mr. Griswold also gave an account of European progress in district heating.

George W. Sauerwein, Cambridge, Mass., presided over the final session, which included six talks on steam mains and connections.

A New Radiometer Measuring Directional Mean Radiant Temperatures†

By Vagn Korsgaard*, Copenhagen S., Denmark

SUMMARY—The special radiometer described was developed to measure directional mean radiant temperatures. The instrument has been successfully used in a test room with highly reflective walls.

THE instrument described in this paper is a special radiometer developed for use in the investigation of the thermal radiation field in rooms. The nature of this field is specified when the directional mean radiant temperature is known for every point in all directions; this directional temperature has been defined in a previous paper[1].

The principle on which the construction of the radiometer is based is as follows: the temperature difference between two small square pieces of cardboard of equal size, placed in the same plane and close together, will depend upon the directional mean radiant temperature, DMRT, of the room with respect to the front sides of the small squares when the front sides of the two squares have different emissivities.

It can be shown theoretically (see Appendix) and verified experimentally that the temperature difference between the two pieces of cardboard is proportional to the difference between the mean temperature of the two squares and the DMRT within the temperature ranges usually prevailing in buildings; hence, the equation to be used with the radiometer is

$$\text{DMRT} = \frac{t_1 + t_2}{2} + k\,(t_1 - t_2) \qquad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where k is an apparatus constant and t_1 and t_2 are the temperatures of the high-emissivity and low-emissivity squares, respectively.

The radiometer is shown schematically in Fig. 1. Instead of two squares, four squares of cardboard are used, two of which are blackened and two of which are covered with bright aluminum foil and arranged symmetrically as shown. The temperature difference between the black and the bright squares is measured by means of a thermopile consisting of 32 copper-constantan thermocouples in series, with 16 *hot* junctions glued to the back of each of the two black squares and 16 *cold* junctions glued to the back of each of the two bright squares.

The mean temperature of the black and bright squares is measured by means of a thermocouple with one junction placed between the four squares and the other junction placed in ice water in a thermos bottle.

The radiometer is calibrated by means of the apparatus shown in Fig. 2. This consists of an open double-walled container permitting water to circulate around the inner container and thus keep this inner surface at any uniform temperature desired. To calibrate, the instrument is placed in front of the opening of the inside-blackened container while corresponding temperature differences between the radiometer and container and between the black and bright squares are measured for different water temperatures and plotted against each other as shown in Fig. 3. These differences fall on a straight line, as was to be expected from the theory. The numerical results of Fig. 3 refer only to the original instrument as used in these studies;

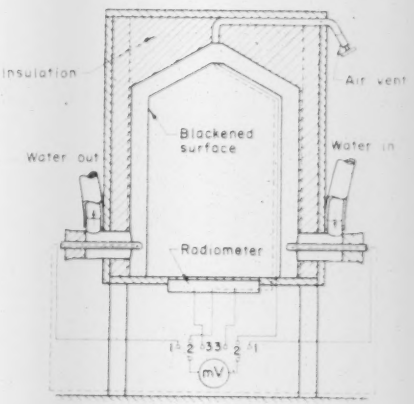

Fig. 2—Calibration apparatus

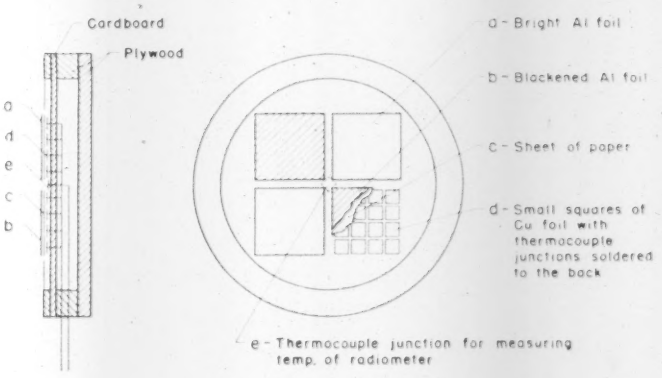

Fig. 1—The radiometer

[1] This paper and a previous one (published in ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, June 1949) are based on theoretical and experimental work performed by the author in 1945 at the Heating and Ventilating Research Laboratory of the University of Technology of Copenhagen, Denmark, on a scholarship from the Council of Technical-Scientific Research of Denmark, and written while in residence at ASHVE Research Laboratory, March 24-June 25, 1948.

*Fellow of the American-Scandinavian Foundation and mechanical engineer.

†Necessity of Using a Directional Mean Radiant Temperature to Describe the Thermal Conditions in Rooms, by Vagn Korsgaard. (ASHVE JOURNAL SECTION, *Heating, Piping & Air Conditioning*, June 1949, p. 117.)

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the symbol t_o there denotes the DMRT.

The radiometer was used to measure the DMRT of a small model test room (see Fig. 4) heated by a panel radiator placed near the floor and on the centerline of one of the walls.

The directional mean radiant temperature of the test room was measured both when all inside surfaces were blackened and when only the floor and radiator were blackened and the walls and ceiling were covered with bright aluminum foil. In both cases the DMRT was measured for 23 different places and for each place in 26 different directions of the radiometer.

It was found that the average DMRT of the room was 5.2 F deg higher when the walls and ceiling were reflective than when they were blackened. The temperature of the radiator was kept constant at 125 F and the temperature of the walls, floor and ceiling at 70 F in both cases.

To see how well the DMRT measured with this radiometer checked with the equations for the DMRT given in the previous paper[1], the DMRT was computed for six different directions in the middle of the test room. Good agreement was found in all cases.

Conclusions

1. The basic principles of the radiometer and its construction are very simple, and by further investigations it should be possible to develop a complete theory for the thermal sensitivity of the radiometer and hence make its construction still more sensitive.
2. The calibration of the radiometer is simple.
3. Experience up to this time has shown that the radiometer is very handy and durable and further requires only a few minutes to reach equilibrium.
4. The radiometer is relatively inexpensive.

Appendix

Refer to the schematic diagram of Figure 5. Elements 1 and 2 are the high-emissivity and low-emissivity squares, respectively. An imaginary surrounding hemisphere is considered to have the uniform temperature t_o, where t_o is the directional mean radiant temperature for the radiometer. The section I denotes the back of the instrument assembly.

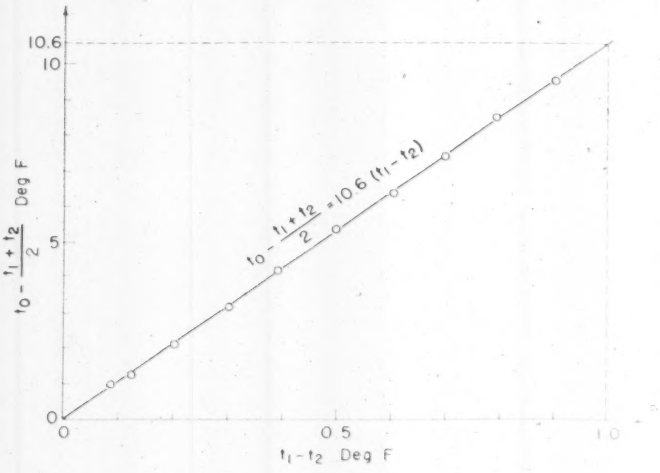

Fig. 3—Calibration curve for the radiometer

The heat balance equations for the Elements 1 and 2 are as follows:

(radiant exchange, element to hemisphere) = (radiant exchange, instrument to element) + (convection, air to element)

Element 1

$$e_1 (h_r)_1^{\circ} (t_1 - t_o) A_1 = e_{s1} (h_r)_1^{I} (t_1 - t_i) A_1 + (h_c)_1 (t_{air} - t_1) (2A_1) \quad \ldots\ldots (2)$$

Element 2

$$e_2 (h_r)_2^{\circ} (t_2 - t_o) A_2 = e_{s1} (h_r)_2^{I} (t_1 - t_2) A_2 + (h_c)_2 (t_{air} - t_2) (2A_1) \quad \ldots\ldots (3)$$

Define an equivalent source temperature t_s and equivalent combined conductances h_1 and h_2 such that Equations 2 and 3 can be written

$$e_1 (h_r)_1^{\circ} (t_1 - t_o) A_1 = h_1 (t_s - t_1) A_1 \quad \ldots\ldots (4)$$

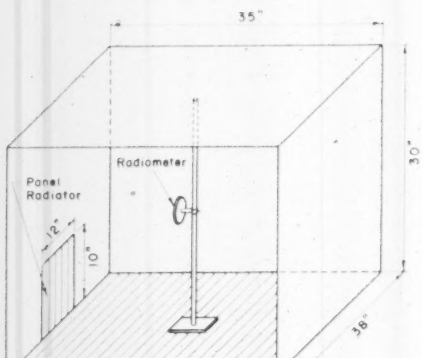

Fig. 4—Small model test room

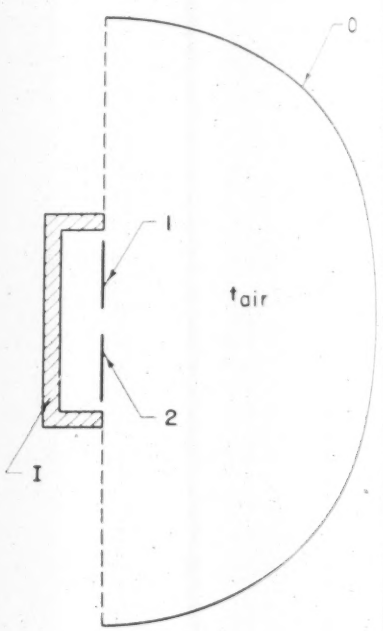

Fig. 5—Schematic diagram of system for derivation of radiometer equation

rather small under room conditions. Hence, a good approximation can be made by writing

$$(h_r)_1 (t_1 - t_o) = (h_r)_2 (t_2 - t_o) = (h_r)_{\frac{t_1+t_2}{2}} \left(\frac{t_1+t_2}{2} - t_o\right) \quad (6)$$

By this substitution and subtraction of Equation 5 from Equation 4,

$$(h_r)_{\frac{t_1+t_2}{2}} \left(\frac{t_1+t_2}{2} - t_o\right)(e_1 - e_2) = h\,(t_2 - t_1) \quad (7)$$

This leads to the *radiometer equation* for the directional mean radiant temperature,

$$t_r = \left(\frac{t_1+t_2}{2}\right) + k\,(t_1 - t_2) \quad (8)$$

where k is an apparatus constant to be established by calibration.

If in the above equation the temperature difference $(t_1 - t_2)$ is equal to zero, it will be seen that $\left(\frac{t_1+t_2}{2}\right) - t_1 = t_2$ is equal to t_r, or to the DMRT of the room with respect to the radiometer.

This principle has been used in a special form of the radiometer, when the back was equipped with some heating device which made it possible to give the front of the radiometer any temperature wanted.

"TEMPERATURE AND HUMAN LIFE"

By C.-E. A. Winslow and L. P. Herrington

Dr. Winslow, one of the authors of this book, is a past president of the ASHVE, and former director of the John B. Pierce Laboratory of Hygiene, New Haven, Conn. Mr. Herrington is the present director of the Laboratory.

The reader will quickly recognize this book as a convenient reference to the list of prominent researchers who have participated in the origin, progress and development of physiological research pertaining to the effect of environmental conditions on human beings.

Chapter I deals with background knowledge in the field of metabolism (the physiological process which is the basis of life) and also with the reasons why air conditioning is so important.

Chapters II and III summarize the information accumulated by the authors and others on the basic problems of thermal interchange between the body and its environment, the mechanism by which the body adjusts itself to that environment, and the limits of such adjustment. In this field it has been possible to develop experimental techniques (called partitional calorimetry) capable of adaptation to many problems besides those already solved, and to derive simple mathematical formulas by which the influence of various atmospheric conditions upon individuals operating at various metabolic rates can be predicted with a high degree of accuracy.

Chapter IV summarizes some of the major conclusions reached as a result of the research on acclimatization of military personnel to extremes of heat or cold, and the effect of various types of clothing developed for war purposes.

Chapter V outlines the fundamental objectives to be attained in air conditioning of occupied spaces. Chapter VI reviews briefly the procedure by which the heating and ventilating engineer obtains these objectives.

Chapter VII reviews the effect and influence of climate and seasons upon health, and discusses the relation of atmospheric conditions to incidence of infections of the upper respiratory tract. The chapter also contains a summary of methods used in determining the conditions producing peaks in various types of diseases, and discusses the climatic factors which influence the transmission of germ diseases, or affect the general vital resistance of the human body.

The book may be obtained from Princeton University Press, Princeton, N. J., at $3.50 per copy.

FLUORESCENT TUBES NEED CARE IN HANDLING

Danger of poisoning from broken fluorescent lighting tubes has been the subject of considerable comment in the newspapers and periodicals. This danger arises from the poisonous beryllium and mercury powders coating the inner surface of the tubes. Because fluorescent lighting is widely used in homes, stores and factories, the hazard affects a great many persons. The following remarks from the Illinois Health Messenger, Illinois Department of Public Health, give important points in the handling of fluorescent tubes.

Cuts by glass from broken tubes heal very slowly and can cause tumorous growths requiring removal by surgery. Inhaling the powder may produce tumors in the lungs.

How to Handle Tubes

Always handle fluorescent tubes with care. Wear gloves when handling them. In case of breakage, leave the area immediately until the powder has had a chance to settle.

Discarding burned-out tubes is a dangerous practice. They may be broken by trash collectors or picked up and used as playthings by children. Householders, janitors and custodians should dispose of the tubes by breaking them under water or in a wet cloth or burlap bag. The broken tubes should then be discarded without opening the bag. It would be better, of course, to bury them where there is no danger of their being accidentally dug up.

City sanitation officials share in the responsibility of proper disposal of the tubes so that innocent citizens will not salvage them. The best way to dispose of trash is by the sanitary landfill method. In this method, trash and garbage are dumped into a trench and covered with a layer of earth. A sanitary landfill will do away with unsightly landmarks as well as health menaces.

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MEMBERS COMBINE WORK AND P

ASHVE registration headquarters

Pres. A. E. Stacey, Jr., opens the meeting

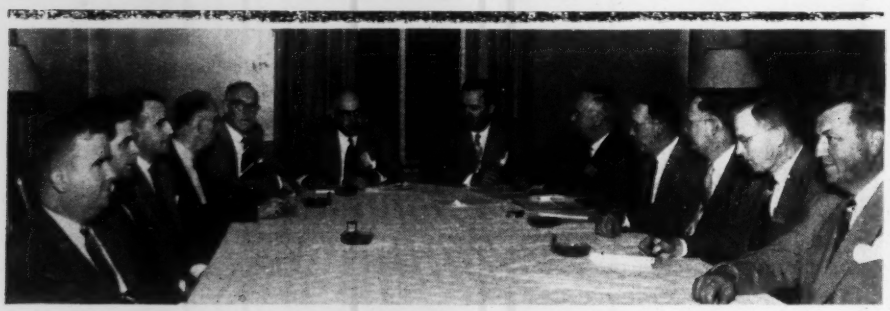
TAC on Cooling Load

(L. to R.) W. F. Friend, Prof. Carl Kayan, W. E. Zieber, *Chairman*, Miss I. Jahn, James Livermore, George Parmelee

1st Vice Pres. Lester T. Avery conducts Tuesday session

The Chapter Delegates in session

2nd Vice Pres. L. E. Seeley presides at Wednesday meeting



TAC on Panel Heating and Cooling

(L. to R.) C. F. Baester, C. E. Abbey, John James, I. M. Van Nieukerken, D. L. Mills, P. B. Gordon, L. N. Hunter, Cyril Tasker, C. A. McKeeman, H. A. Lockhart, C. M. Humphreys, and R. E. Moore.

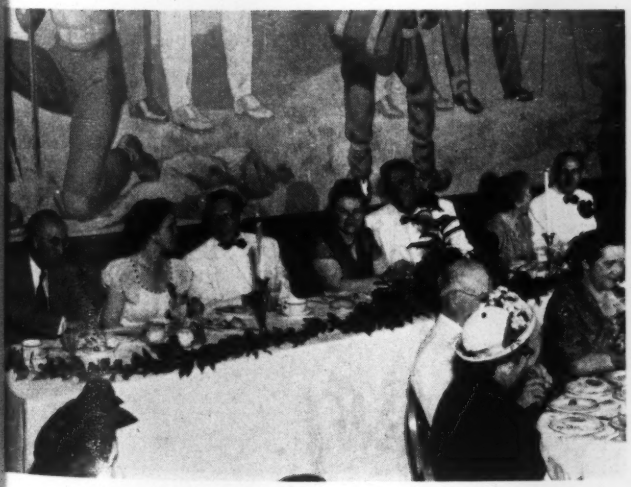
PLAY AT THE ASHVE MEETING

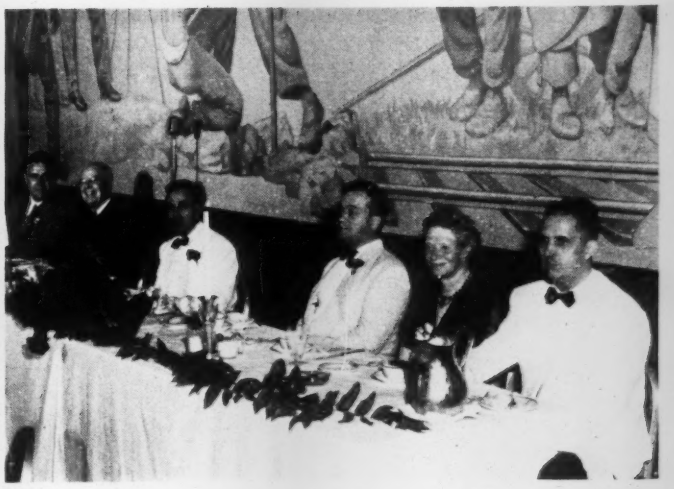
Fred Schernbeck gets a wig from Mrs. Haines

The barbers do their stuff

The Smorgasbord Quartette—Messrs. Nichols, Wissmiller, Haines and Locke

The men's beauty contest judged by Mrs. A. E. Stacey, Mrs. Ernest Szekely, and Miss D. M. Mildner





At the banquet speakers' table

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Summary of Chapter Meetings

SHREVEPORT CHAPTER HEARS GLICKMAN

The adjustment of human beings to temperature changes takes about 13 minutes with no ill effect, Prof. Nathaniel Glickman, Chicago, told members and guests of the Shreveport Chapter at the dinner meeting May 17.

Speaking of the transition of human beings from comfortable hot surroundings, Professor Glickman, who has been conducting research on male subjects at the University of Illinois Medical school, noted that there is an increase of heart beat, skin temperature and blood pressure but that after a few minutes adjustment is complete.

At the college of medicine in the University of Illinois, tests are now going on, Prof. Glickman said, to determine the effect of sudden temperature change on women and on those who suffer from *orthostatic hypertension*. The latter is a fainting spell which occurs on a hot summer day in some individuals who have been standing for some time. Low blood pressure and the standing position of the body limit the supply of blood to the heart and brain, and fainting results.

Another condition to be studied, Professor Glickman stated, is the effect of climate changes which take place when long distance travel is involved.

LPI Student Branch is launched
(L. to R.) Prof. A. E. Williams, faculty adviser; Joe Yoder, president LPI Student Branch; R. F. Taylor, South Texas Chapter; A. H. Otto, president Shreveport Chapter; and J. B. Williams, vice president of LPI Student Branch

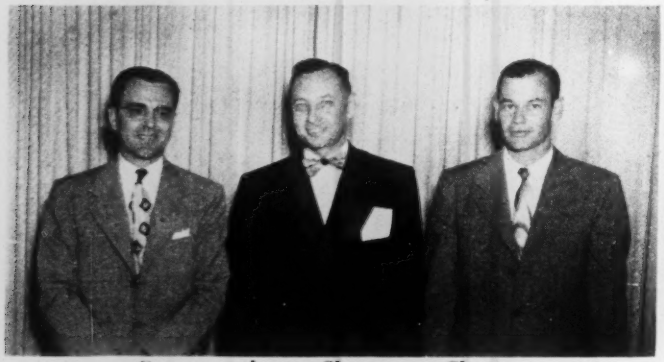
LPI STUDENTS GET CHARTER AT SHREVEPORT MEETING

On the first anniversary of the Shreveport Chapter, 76 members and guests gathered for the presentation of a charter to the Louisiana Polytechnic Institute Student Branch on May 17 at Shreveport.

Presented by R. F. Taylor, ASHVE Council member, the charter was received by Joe Yoder, President of the LPI Student Branch. R. M. Hood spoke on the value of student membership and A. H. Otto, president of Shreveport Chapter, extended congratulations to the new Student Branch.

Visitors from the Louisiana Polytechnic Institute at Ruston were Prof. A. E. Williams, faculty adviser of the Branch; Prof. Ben F. Bogard, Asst. Dean of Mechanical Engineering; Professors J. J. Thigpin, T. H. Goodgame, L. R. Daniels, and Dr. Amos Ford, director of public relations.

M. J. Murray, Dallas, represented the North Texas Chapter at the meeting and representatives for the South Texas Chapter included D. M. Mills and Mr. Taylor of Houston.



Guest speaker at Shreveport Chapter
(L. to R.) A. H. Otto, president, Prof. Nathaniel Glickman, Chicago, and Joe Yoder, president LPI Student Branch

Louisiana students receive Charter
(L. to R.) R. F. Taylor, South Texas Chapter; Joe Yoder, president LPI Student Branch; A. H. Otto, president Shreveport Chapter

• ATLANTA—April 1, 1949. A technical film and several business reports were included in the program for the April meeting. The film, in color, described the design, construction and application of large power boilers.

H. King McCain reported for the Committee on Research, giving a summary of present facilities and activities at the Society's Research Laboratory in Cleveland. Arrangements for the May meeting were described by G. B. Hightower, with the program to consist of a dinner and dance. F. W. Bull gave the treasurer's report.

• CENTRAL NEW YORK—May 25, 1949. A joint annual clambake outing of ASHVE and *ASRE* was held in Syracuse. The day was clear and crisp which contributed to participation in a variety of activities such as softball and horseshoe pitching. Following dinner, a social hour was held. Attendance 109.

• CENTRAL OHIO—May 16, 1949. Factors involved in eliminating smoke were described by H. C. Baughman, city smoke abatement engineer, who spoke at the meeting in Columbus. Mr. Baughman supplemented his talk with charts, placards and color slides.

After the discussion period, the topic of smoke abatement was continued by R. M. Keats, who showed color movies which gave the audience a picture of the city smoke situation from the air.

New officers installed at the meeting are: *President*—E. A. Norman, Jr.; *Vice President*—H. G. Hays; *Secretary*—R. S. Curl; *Treasurer*—A. D. Bogen.

W. M. Myler, Jr. invited members and their families to attend an open house at Surface Combustion Corp., Columbus plant on May 20th. Mr. Bogen announced that the annual picnic would be held June 23 at Wyandotte Country Club. Attendance 55.

• CENTRAL OHIO—April 18, 1949. The meeting was held in the Lustron Corp. plant in Columbus. After the business meeting members and guests were conducted through the plant on an inspection tour. The visitors were also invited to go through a newly constructed house which was located nearby. Attendance 120.

• CINCINNATI—April 5, 1949. A sound film describing the development of the steam boiler was shown at the April meeting in Cincinnati. After the presentation of the film, W. H. Junker gave a discussion of a new high pressure boiler recently installed in a local plant.

Vice Pres. K. B. Little read a telegram from M. E. Mathewson, chapter president, who was unable to attend. A. H. Gerdsen gave a program report and T. D. Reiley reported on membership: F. B. DeBra was named chapter representative to work with the ASHVE Committee on Research in promoting additional research projects. Attendance 36.

• CONNECTICUT—May 24, 1949. A round table discussion of fans and air motion was conducted by seven men from The Torrington Mfg. Co., Torrington, Conn., at the Connecticut Chapter dinner meeting, held at the company's plant. The members and guests had previously made an inspection trip of the plant.

Committees for the year 1949-50 were named as follows: *Meetings:* R. W. Sidbury, *chairman;* J. J. Hull, C. J. Wahnquist, Jr., T. L. Arnold, S. R. Osborne, G. F. Nieske. *Membership:* E. R. Clement, Sr., *chairman;* C. L. L'Hommedieu, R. C. Atherton, W. O. Mosher, P. J. Lamourex. *Legislative: Chairman,* C. W. Freeman, W. K. Simpson, L. O. R. Clark, L. A. Teasdale. *Finance:* A. J. Lawless, *chairman;* L. E. Pelletier, H. C. Kelly, C. E. Weisner, J. R. Smak. *Enforcement:* D. M. Hummel, *chairman;* C. F. Ganter, Walter Heywood. *Chapter Delegate:* E. C. Marsden. *Alternate:* D. M. Hummel. *Connecticut Technical Council:* Winfield Roeder, D. M. Hummel.

Pres. Winfield Roeder announced that the annual outing would be at Race Brook Country Club, New Haven, June 28. Attendance 40.

• CONNECTICUT — April 21, 1949. The following officers were elected at the meeting in Waterbury: *President*—Winfield Roeder; *Vice President*—David M. Hummel; *Treasurer*—A. J. Lawless; *Secretary*—T. L. Arnold. *Board of Governors:* J. R. Smak, G. F. Nieske, E. C. Marsden.

President Roeder then received the gavel from retiring president E. C. Marsden and introduced the speaker, F. Leroy Scovill, Jr. Mr. Scovill spoke on *Copper Tubing in Radiant Panel Heating.*

Reports were made by D. M. Hummel and W. O. Mosher. It was decided to hold an outdoor meeting in June. Attendance 46. Attendance ratio 0.42*.

• GOLDEN GATE—May 5, 1949. The development of chemical sterilization of air since its beginning in 1868 was outlined by Lewis Sauer, of Air Conditioning, Inc., in a talk before the Chapter in San Francisco. Speaking on *Air Sterilization with Glycol Vapors,* Mr. Sauer described developments made during World Wars I and II and explained present day methods of injecting glycol vapors into the air.

Correspondence from the Society and an abstract of the April Council meeting minutes were read to the membership. Committee chairmen reported on activities of their committees. The technical committee gave a report and discussion of the proposed code governing panel heating installations in San Mateo, Calif. Attendance 51.

• INDIANA—April 22, 1949. Everyday engineering problems in heating and ventilating helped develop the air conditioning of railway passenger cars, J. S. Locke told chapter members at the meeting in Indianapolis. Mr. Locke, sales manager, Minneapolis-Honeywell Regulator Co., Minneapolis, traced the history of passenger comfort from the early 1900's to the present.

* Note: The attendance ratios shown represent the membership attendance divided by the chapter membership. These ratios will be useful as a partial indication of interest shown by local chapter members in various types of subjects programmed by the various chapters and may be useful in deciding on subjects for chapter meetings.

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S. E. Fenstermaker was presented with a life membership certificate by I. W. Cotton on behalf of the Indiana Chapter. Mr. Fenstermaker responded with an account of the history and growth of the Society over a period of more than 30 years.

The program for the next month was outlined by C. H. Hagedon. Attendance 45.

• **IOWA**—May 17, 1949. Officers for 1949-50 were elected at the May meeting in Des Moines as follows: *President*—D. E. Wells; *Vice President*—R. S. Stover; *Secretary-Treasurer*—C. P. North; *Board of Governors:* D. C. Murphy, J. F. Sandfort, C. H. McGuinness.

A talk on the subject of chapter delegates was given by retiring president, D. C. Murphy. Mr. Murphy was presented with a past president's pin by A. L. Walters of Chicago, one of the guests of the evening.

D. E. Schroeder, construction inspector of Iowa State College, Ames, Ia., spoke on *Correcting Unbalanced Heating Systems by Orifices*. Mr. Schroeder gave an example of a building in which orificing was applied, and also used slides to illustrate test runs made to determine orifice sizes. Steps to be followed in orificing a heating system were outlined.

Before the dinner meeting, 25 members and guests made an inspection trip of the new building at Drake University, Des Moines. Attendance 29. Attendance ratio 0.58.

• **KANSAS CITY**—May 2, 1949. Election of officers for the coming year was held with the following results: *President*—Henry Nottberg, Jr.; *Vice President*—W. E. Howarth; *Secretary*—C. W. Schumacher; *Treasurer*—W. A. Reichow; *Board of Governors:* H. E. Gould, L. T. Mart, D. M. Allen.

A. E. Stacey, Jr., ASHVE President, spoke on the history of the Society since its beginning in 1894. He traced the development of THE GUIDE and the JOURNAL and described the establishment of the Society's research work.

Reports were given by Secretary Schumacher and V. N. Elder, president, University of Kansas Student Branch. The new officers of the Chapter were installed by Henry E. Gould. Attendance 80.

• **MASSACHUSETTS** — April 20, 1949. New members elected to the Board of Governors at the meeting in M.I.T., Cambridge are: J. P. Licandro, John Bonner, and C. H. Dow.

P. L. Davidson, consulting engineer from Philadelphia, spoke on *Textile Mill Air Conditioning* and after his talk answered questions asked by the audience.

The meeting was preceded by a group dinner and a social hour in the Campus Room of the M.I.T. Graduate House. Attendance 85.

• **MEMPHIS**—April 18, 1949. New officers elected for the coming year were as follows: *President*—W. L. Wellford, Jr.; *Vice President*—C. S. Fischer; *Treasurer*—R. W. Johnson; *Secretary*—A. T. Bevil.

Speaker of the evening was R. M. Nelson of the Armco Steel Corp., who spoke on *Today's Trend in Metal for Heating and Ventilating*.

Pres. E. E. Scott, presiding over his last meeting of the year, thanked the officers and committees who had served with him during his tenure as president of the Memphis Chapter. Attendance 35. Attendance ratio 0.75.

• **MICHIGAN**—May 17, 1949. At the annual outing held at the Plum Hollow Golf Club, new officers were elected and installed as follows: *President*—L. A. Burch; *Vice President*—C. F. Donohoe; *Treasurer*—G. W. Akers; *Secy.*—J. H. Spurgeon; on the *Board of Governors:* R. H. Oberschulte, E. H. Clark and T. H. Mabley.

On assuming office, President Burch presented past president E. F. Hyde with a plaque and memory book on behalf of the Michigan Chapter in appreciation of Mr. Hyde's services for the past year. Reports were made by Mr. Donohoe and by F. X. Marzolf. Attendance 81. Attendance ratio 0.44.

• **MONTREAL**—April 18, 1949. Residential Heating was discussed by Carl F. Boester, housing consultant, Purdue Research Foundation, Lafayette, Ind., guest speaker, at the April meeting in Montreal. Retiring president Leo Garneau gave a summary of last year's activities and noted that the membership had increased 25 percent. A. B. Madden, past president, introduced the newly elected officers and expressed appreciation for the work done by the retiring officers. Attendance 65.

• **NEW YORK**—May 16, 1949. Heating a home by means of solar energy stored in chemicals was the subject of the talk given by Dr. A. Nemethy, consulting engineer, Dover, Mass. Describing the installation in the *solar house*, where he lives with his family, Dr. Nemethy said that adequate heating was obtained throughout the past winter, with the use of 21 tons of Glauber's salt as the heat storage medium.

Pres. A. A. Bearman announced that special cars to Minneapolis would be started in New York on two railroads, and members were requested to notify the Society office if they expected to attend the Semi-Annual Meeting.

Alfred J. Offner, past president of the Society, presented the gavel to incoming president H. S. Johnson.

A report covering the past year was read by President Bearman with special appreciation to the following who served as chairmen of various committees: C. S. Koehler, A. A. Giannini, Bernard Leventhal, R. L. Stinard, H. S. Birkett, and Carl H. Flink. Attendance 120. Attendance ratio 0.26.

• **NORTHERN OHIO**—May 9, 1949. At the meeting in Cleveland, the following were elected for 1950: *President*—R. L. Byers; *Vice President*—W. M. Rowe; *Secretary*—G. V. Parmelee; *Treas.*—R. E. Sherman; *Board of Governors:* W. R. Moore, John Richmond, and D. E. Mannen.

The work of the Research Laboratory of the Society was described by Cyril Tasker, director of research. Mr. Tasker then introduced mem-

bers of the laboratory staff, who reported as follows: *Room Air Distribution*—H. B. Nottage; *Solar Radiation*—G. V. Parmelee; *Panel Heating*—C. V. Franks; *Navy Project*—R. G. Huebscher; *Fuel Oil Tests*—D. W. Locklin.

R. E. Leising reported for the membership committee and L. C. Burkes outlined the program for June. The election of J. E. Wilhelm to the presidency of the *Cleveland Technical Societies Council* was announced by Pres. W. R. Moore. Attendance 55.

• **OKLAHOMA**—May 3, 1949. Newly elected officers are: *President*—H. S. Shafer; *Vice Pres.*—J. R. Patten; *Secretary*—R. E. Swan; the *Board of Governors:* J. J. Spaan, Jr., W. W. Frankfurt, and G. T. Donceel.

Air conditioning applications in mines, tobacco factories and textile mills were discussed by A. E. Stacey, Jr., president of the Society. President Stacey also gave an account of the development of the Society since its beginning. Attendance 45.

• **ONTARIO**—May 2, 1949. Engineers are people, speaker R. G. Lewis declared in a humorous address given at the May meeting in Toronto. Mr. Lewis is editor and publisher of the Canadian Broadcaster and Telescreen Magazine of Toronto.

A number of business matters were taken up at the meeting. Three chapter representatives were named for the following committees: ASHVE *Promotion of Research*—F. W. Chambers; *Air Pollution*—G. P. Cooper; *City Heating By-Law*—E. G. Spall.

Average attendance during the past year was 92, said C. D. Waldon, chairman of the attendance committee, in a report to the group. Other reports were given as follows: W. H. Evans—*papers;* J. J. Lawlor—*membership;* N. A. Smith—*fellowship;* P. M. Butler—*greeters;* N. W. Kingsland—*publicity;* Mr. Chambers—the *Affiliated Engineering Societies of Ontario.* D. L. Angus reported that William Smardon had been given the Ontario Chapter's award for the best University of Toronto student thesis. Title of the thesis is *Application of the Heat Pump for the Heating of Canadian Homes.*

Mr. Angus also reported on the auditing committee. A vote of thanks was given to Secretary H. R. Roth.

At the May meeting in Toronto, the following officers for the coming year were elected: *President*—A. J. Strain; *Vice President*—J. H. Fox; *Secretary-Treasurer*—H. R. Roth. *Board of Governors:* William Philip, H. A. Baxter, N. W. Kingsland, E. G. Spall, *ex-officio.*

Retiring president E. G. Spall turned the gavel over to President Strain. Mr. Strain on behalf of the Ontario Chapter extended the Chapter's appreciation for Mr. Spall's successful term in office and presented him with a diamond studded emblem as past president. He also presented Mr. Spall with a certificate signed by the Board of Governors in appreciation of his services.

John Thompson was named chairman of the golf game for the coming year. Attendance 67. Attendance ratio 0.42.

• **PITTSBURGH**—May 9, 1949. At the May meeting, retiring president H. E. Park turned the gavel over to Pres. H. J. Kirkendall. Other officers elected were: *Vice President*—A. F. Metzger; *Secretary*—E. H. Riesmeyer, Jr.; *Treasurer*—B. B. Reilly. The new Board of Governors includes H. E. Park, W. D. Simpson and B. R. Small.

J. L. McCann reported that the meeting between the ASHVE and *ASRE* golf groups will be the first Friday in June. A social program followed the business meeting. Attendance 49.

• **ST. LOUIS**—May 3, 1949. Officers for 1949-50 were elected as follows: *President*—W. A. Russell; *1st Vice President*—J. S. Rosebrough; *2nd Vice President*—C. H. Burnap; *Secretary*—H. C. Sharp; *Treasurer*—L. L. Hamig; *Board of Governors:* G. W. Pieksen, G. H. Bemarkt, E. T. Clucas and B. L. Evans.

The possibilities of atomic energy in naval practice were outlined by Prof. R. N. Varney, Washington University, St. Louis. Professor Varney discussed problems in the power field and in the application of atomic energy to military requirements.

Reports were given by H. C. Sharp, W. A. Russell, J. H. Carter, and H. R. Halt. Messrs. Evans and Bemarkt also reported. Attendance 54. Attendance ratio 0.30.

• **SOUTH TEXAS**—May 19, 1949. Among the guests who heard Prof. Nathaniel Glickman, University of Illinois, speak at the meeting in Houston were two physicians, who were greatly interested in the engineering viewpoint on air conditioning and the human body.

A resolution was offered by R. F. Taylor to retiring vice president L. L. Ladewig, who is moving out of the area of the Chapter.

Officers elected at the meeting are: *President*—R. J. Salinger; *Vice President*—H. W. Broadwell; *Secretary*—G. J. Collins; *Treasurer*—C. L. Fleming. *Board of Governors:* Roy E. Armstrong, E. G. Floeter, Jr.

Mr. Fleming reported on membership and D. M. Robinson reported for the program committee. Other reports given were: J. C. Lewis for the publicity committee; Prof. A. A. Rasmussen, University of Houston, for the research committee; Mr. Collins, for the Board of Governors.

D. M. Mills was elected delegate to the semi-annual meeting. B. P. Fisher spoke on job placement and also local research. C. C. Quin, retiring president, was presented with a past president's pin by R. J. Salinger on behalf of the Chapter.

The next meeting was announced as a barn dance on June 27. Attendance 89. Attendance ratio 0.35.

• **SOUTH TEXAS**—April 15, 1949. Economic statistics for air conditioning equipment were given by Charles Blum, of the Houston Lighting and Power Co. before the Chapter meeting in Houston.

Secretary R. J. Salinger read an announcement of the International

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Congress in Mexico. The invitation of the Minnesota Chapter to attend the Minneapolis meeting was read.

S. F. Atlas discussed building codes, and A. F. Barnes told members about the recent symposium of the Engineers' Council. A special meeting was announced for June, with the program to be in charge of A. F. Barnes, chairman, J. C. Lewis, E. G. Floeter, Jr., and R. A. Molnari.

Minimum stack heights were discussed by E. L. Howell, and R. F. Taylor reported on the April Council meeting in Washington. Attendance 65. Attendance ratio 0.26.

• **WASHINGTON, D. C.**—April 13, 1949. Election results for 1949-50 officers in the Chapter were as follows: *President*—P. R. Achenbach; *Vice President*—F. M. Thuney; *Treasurer*—R. L. Bridgman; *Secretary*—J. G. Muirheid; *Board of Governors:* John Everetts, Jr., A. S. Gates, Jr., W. C. Jones.

Results obtained in test homes using baseboard heating were described by Prof. W. S. Harris, of the University of Illinois, Urbana. Professor Harris spoke of the various types of heating mediums used in the test homes studied as a special research project at the university.

An outdoor meeting was voted by members for some time in the summer. F. M. Thuney announced the program for next month. A past president's pin was given to Mr. Gates, retiring president. Attendance 75. Attendance ratio 0.35.

• **WESTERN MICHIGAN**—May 19, 1949. Ninety-two members and guests attended the dinner meeting of the Western Michigan Chapter held at the Gull Lake Country Club. A trio of musicians from Kalamazoo College and a quartet provided music and entertainment.

Election results were as follows: *President*—J. L. Alexander; *Vice President*—K. E. Robinson; *Secretary*—L. A. Calcaterra; *Treasurer*—J. T. Anderson. *Board of Governors:* H. W. Wolters, W. C. DeRoo, H. R. Limbacher.

The new officers were installed by O. D. Marshall, assisted by H. D. Bratt. The Chapter historian was asked to be the recipient of old records in possession of the Chapter secretary. After the business meeting, the group was entertained by an hour of movies. Attendance 92.

• **WESTERN NEW YORK**—May 9, 1949. New officers elected at the May meeting in Buffalo are: *President*— F. J. Weber; *1st Vice President*—J. H. Bryce; *2nd Vice President*—T. F. Killeen; *Secretary*—J. M. Quackenbush; *Treasurer*—B. C. Candee; *Board of Governors:* Edwin Woolcock, Joseph Davis, M. C. Beman, W. R. Heath and S. M. Quackenbush. Roswell Farnham was elected delegate to the 56th Annual Meeting.

Speaker of the evening was H. A. Mosher, Eastman Kodak Co., Rochester, discussing the question, *When is Factory Air Conditioning Advisable?* Slides illustrated his talk which was followed by a question and answer period. Attendance 47.

• **WESTERN NEW YORK**—April 25, 1949. Speaker at the April meeting in Buffalo was J. W. May, of the American Air Filter Co., Louisville, Ky. Mr. May spoke on the subject *Theory of the Electrostatic Precipitation of Rain*. A discussion period followed the talk.

It was announced that the topic for next month's meeting would be air conditioning the modern factory. Joseph Davis reported on the research program of the Society. Attendance 82.

• **WISCONSIN**—May 10, 1949. A. E. Stacey, Jr., Syracuse, N. Y., ASHVE President, was guest speaker at the dinner meeting held in Milwaukee. President Stacey described the ASHVE research program and gave historical highlights in the development of the Society.

The following were elected: *President*—B. M. Kluge; *Vice President*—F. J. Nunlist, Jr.; *Treasurer*—H. F. Brinen; *Secretary*—J. A. Lofte; *Board of Governors:* E. W. Gifford, F. W. Goldsmith, W. A. Ouweneel.

Reports were read by the chairmen of the research, employment, publicity, public relations, code and membership committees and by the ASHVE editor of *Milwaukee Engineering*. Louis Placker reported on next month's outdoor program.

Mr. Brinen read a letter from Mrs. H. W. Ellis, who thanked the Chapter for the resolution sent to her at the time of the death of Chapter member H. W. Ellis.

Mr. Kluge, incoming president, received the gavel from retiring president Ouweneel, who then expressed his appreciation to the Chapter for its cooperation throughout the year. Mr. Ouweneel then received the past president's pin from Mr. Kluge. Attendance 54. Attendance ratio 0.34.

Student Branches

▲ **CCNY**—May 11, 1949. At the May meeting of the College of the City of New York, air circulation and distribution as a problem in air conditioning design was the topic discussed by Prof. Arthur Repetto. He stressed the choice of various types of grilles for the different situations that confronted the engineer. An informal question and answer period followed.

Vice Pres. M. F. Shakun reported on the employment committee. A film was shown describing the assembly and operation of a type of package air conditioning unit. Attendance 34. Attendance ratio 0.89.

▲ **CCNY**—April 27, 1949. A film on air conditioning was shown, and the employment and treasury committees gave reports. Pres. Irving Kleinman presided. Attendance 21. Attendance ratio 0.56.

▲ **CCNY**—April 7, 1949. At a joint meeting held with the student branch of *ASME*, guest speaker was

Prof. M. C. Giannini of the mechanical engineering department, New York University. His talk on *Mechanical Equipment in Buildings* described requirements of engineers in the design of the heating, air conditioning, plumbing and other equipment used in buildings. The relation of building codes to the equipment was also described. Attendance 54.

▲ CCNY—March 30, 1949. Guest speaker was C. Egbert of the York Corp., York, Pa., who spoke on centrifugal compressors, their operation and application. Sound slides were shown to illustrate the talk. A question and answer period followed. Attendance 20. Attendance ratio 0.53.

▲ NORTH CAROLINA STATE COLLEGE—May 3, 1949. At the meeting in Raleigh, Student Branch officers for the year 1949-50 were elected as follows: *President*—J. J. Andrews; *Vice President*—J. W. Westbrook, Jr.; *Secretary*—E. A. Stroupe; *Treasurer*—W. L. Glasgow; *Reporter*—B. H. Cathey.

Reports were made by the entertainment committee and by J. G. Marshall. Attendance 35. Attendance ratio 0.70.

▲ OREGON STATE COLLEGE—April 20, 1949. At the April meeting in Corvallis, air conditioning was discussed by R. C. Chewning of the office of J. Donald Kroeker, Portland. Mr. Chewning also invited students to attend the annual summer picnic of the Oregon Chapter.

Present officers of the OSC Student Branch are: *President*—John S. Bowen, Jr.; *Vice President*—B. L. Hansen; *Secretary - Treasurer*—Bruce W. Carkin; Faculty Advisor—Prof. Walter Baker. Attendance 20. Attendance ratio 0.46.

▲ PURDUE UNIVERSITY—May 18, 1949. *Air Filtration and Dust Control* was the subject of the talk given by J. W. May, director of research of the American Air Filter Co., Louisville, Ky., before the Purdue Student Branch, Lafayette, Ind. Mr. May described various types of filters used to remove dust particles from air. He also answered questions asked by the audience.

The following students were elected to fill vacancies on the executive committee: P. D. Bailey, D. F. Williams, W. L. Kixmiller and R. L. Ford.

A party scheduled for June 4 was announced by C. M. Wade. The fall meeting was announced for October 5. A. V. Anderson, Jr., gave a talk on job placement in Texas. Attendance 24. Attendance ratio 0.20.

▲ PURDUE UNIVERSITY—April 27, 1949. The atmosphere as affecting the speed of aircraft was the subject of a talk by Robert Beckman, of General Motors Corp., speaking to the Student Branch in Lafayette, Ind. He said that compressibility was a barrier to high speeds and explained it as pressure waves which travel at the speed of sound.

In a report to the group, C. H. Sallman announced that the Purdue Student Branch now had 121 members. M. E. Naftzger reported on Student Branch officers. Attendance 39. Attendance ratio 0.32.

▲ TEXAS A. & M.—May 19, 1949. Election of officers was held at the meeting of the Student Branch in College Station with the following results: *President*—R. N. Hughes; *Vice President*—W. Q. Scott. The election of secretary and treasurer will take place at the first meeting of the fall semester. Other plans for the fall semester were discussed by the membership. Attendance 24. Attendance ratio 0.29.

▲ TEXAS A. & M. COLLEGE—April 21, 1949. Final arrangements for Engineers' Day were made at the April meeting held at College Station. Pres. C. V. Brown announced that equipment would be obtained and demonstrated.

A short report was given by W. L. Hull on the progress being made by the placement committee in obtaining both summer and permanent employment for members of the Texas A. & M. Student Branch. Attendance 25. Attendance ratio 0.33.

▲ UNIVERSITY OF DETROIT—April 1949. Guest speaker was C. F. Mally, of the Mally Corp., Detroit, who gave a talk on *Radiant and Hot Water Heating*. After his talk, an open discussion period was held.

Pres. Joseph Olivieri spoke on the constitution and by-laws of the Student Branch. Attendance 10. Attendance ratio 0.32.

▲ UNIVERSITY OF KANSAS—May 12, 1949. The May meeting was held in the Student Union Building on the campus, Lawrence, Kans.

Speaker of the evening was Mr. Scott of Howarth, Scott and Kinney, a consulting engineering firm of Kansas City. He described human relations problems in the consulting business, such as situations which arise between engineer and architect, or engineer and client. He also showed some charts which were studied by the audience after the question period. Attendance 73. Attendance ratio 0.76.

▲ UNIVERSITY OF TEXAS—April 21, 1949. The regular monthly meeting was held on the campus at Austin, with Pres. Karl Martino calling upon guests and members to introduce themselves.

A. G. Allen gave a report from the social committee. D. R. Dochen gave a report from the placement committee.

Karl Martino introduced Donald Schuett who spoke to the members on the problems of starting an air conditioning business. Attendance 33. Attendance ratio 0.44.

▲ UNIVERSITY OF TEXAS—April 12, 1949. A banquet was held jointly with the Southwest Texas chapter in Austin. John Norris, guest speaker, gave a talk on warm air heating and its theoretical basis. Prof. W. E. Long spoke on employment prospects for college students in heating and air conditioning. Ira Wilke read telegrams from Texas Council members C. R. Gardner and R. F. Taylor, who were unable to attend. George Rhine presided. Attendance 12. Attendance ratio 0.24.

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Candidates for Membership

The Constitution of the Society, as now amended, requires the following mode of procedure in voting on applicants for membership in the Society. All applications for membership are to be sent to the Secretary and the names of applicants and their references shall be printed in the next issue of the JOURNAL of the Society or sent to the members in other approved manner as ordered by the Council. When the replies are received from references, the Candidate's application shall be submitted to and acted upon by the Committee on Admission and Advancement as soon as possible.

When the Committee on Admission and Advancement has acted favorably upon a Candidate's application and assigned his grade, the Council shall vote upon the election of the proposed Candidate for membership by letter ballot. During the past month 91 applications for membership have been received and the names of these men and their sponsors are published in the following list.

Members are requested to scrutinize the list with care. The Committee on Admission and Advancement, and in turn the Council, urge members to assume their share of responsibility of receiving these candidates into membership by advising the Secretary promptly of any whose eligibility for membership is in any way questioned.

All correspondence in regard to such matters is strictly confidential, and is solely for the good of the Society, which it is the duty of every member to promote.

Unless objection is made by some member by July 25, 1949, these candidates will be balloted upon by the Council. Those elected to membership will be notified by the Secretary immediately after election.

AKSMAN, LESTER, Partner, Kool-Flow Co., Brooklyn, N. Y. PROPOSERS: M. M. Pizer, B. V. Blazer. SECONDERS: A. A. Sylvane*, R. L. Dobrin.

ANFANGER, R. A., Engr., Thermodyne Corp., New York, N. Y. PROPOSERS: William Helmrich*, Walter Parrs*. SECONDERS: J. W. Wilson*, R. C. Hollis.

BAVIS, E. M., Pres., The Bavis-Crawford Co., Washington, D. C. PROPOSERS: H. H. Hill, M. F. Hoppe. SECONDERS: J. H. Hanlein, R. L. Bridgman.

BEAUMANOIR, DE L'ANGLE, H., Foreman on Constructions, Thomas O'Connell, Ltd., Montreal, Canada. PROPOSERS: T. D. O'Connell, J. P. Keith. SECONDERS: A. G. Moore, F. A. Hamlet.

BROWN, C. W., Mgr., Owens Corning Fiberglas Corp., Denver, Colo. PROPOSERS: A. S. Smith, J. H. McCabe. SECONDERS: D. J. McQuaid, D. R. Waterman.

BROWN, J. D., Civil Engr., Bridgeport Brass Co., Bridgeport, Conn. PROPOSERS: J. R. Smak, Winfield Roeder. SECONDERS: L. F. Rogers, Arthur Brewer*.

DAVIS, J. P., Davis Brothers, Inc., Detroit, Mich. PROPOSERS: D. S. Falk, Robert Clar, Jr. SECONDERS: C. F. Mally, L. A. Burch.

DILLARD, J. C., Htg. Engr., Industrial Sprinkler Corp., High Point, N. C. PROPOSERS: M. F. DuChateau, W. D. Graham, Jr. SECONDERS: W. D. Graham, Sr., P. L. Guest, Jr.

DUFFIELD, C. H., Design Engr., Stevens Heating & Supply Co., Reno, Nev. PROPOSERS: H. R. Stevens, J. E. Stevens. SECONDERS: M. E. Lamb*, K. P. Ruthenberg*.

DUPUIS, J. F., Chief Draftsman, National Heating Products, Ltd., Montreal, Canada. PROPOSERS: J. R. Dupuis, W. W. Timmins. SECONDERS: W. E. Williams, B. J. Horsburgh.

DURHAM, L. H., Vice Pres., Terrell E. Moseley, Inc., Lynchburg, Va. PROPOSERS: F. L. Doering, R. L. Brown. SECONDERS: Frederick Grim, M. I. Taylor.

EAGEN, J. H., Archt. Engr., Hoffman & Crumpton, Archts., Pittsburgh, Pa. PROPOSERS: E. C. Smyers, H. W. Rainey, Jr. SECONDERS: H. L. Moore, C. H. Schneider.

FAVRE, P. J., Owner & Mgr., Industrial Burner Sales, Spokane, Wash. PROPOSERS: E. C. Connell, H. S. Jennings. SECONDERS: E. W. Bunnell, W. C. Vradenburg.

FLANAGAN, W. M., Sales Engr., C. A. Dunham Co., Ltd., Toronto, Ont., Canada. PROPOSERS: Ernest Fox, M. W. Shears. SECONDERS: M. C. Bailey, W. R. Blackhall.

FREESE, D. S., Engr. Head Insulation Dept., Otis Massey Co., Ltd., Houston, Tex. PROPOSERS: Norman Way, W. J. Way. SECONDERS: E. G. Floeter, Jr., J. C. Lewis.

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CARLE J. MERRILL

Carle J. Merrill, recently elected a Life Member in the Society, died on May 6, 1949. He was 65 years old.

Mr. Merrill was a native of Maine and received a B.S. degree at Tufts College, Medford, Mass. He began his career in the engineering department of B. F. Sturtevant Co., Boston. Following with two years in the sales department, he became sales engineer, handling such work as dye house ventilation and various fan applications including drying and heating.

In 1912, Mr. Merrill became manager of E. E. Cutler Co., Portland, Me. During this time he designed and installed fan work for the Winchester Repeating Arms Co., New Haven, Conn.

In 1916, he opened his own business of C. J. Merrill, Inc., engineers and manufacturers, Portland, Me. From that time until his death, he held the position of treasurer and manager. During his lifetime he made a specialty of installation and design of fans for such industries as paper and textile mills.

He joined the Society in 1919 and became a Life Member this year.

WILBUR R. FITCH

Wilbur R. Fitch, Belmont, Mass., died on May 22, 1949, at the age of 68. Mr. Fitch attended high school in Winchester, Mass., and studied refrigeration at Massachusetts Institute of Technology, Cambridge. He began his engineering career as a draftsman in 1900 with Eastern Cold Storage Co. Later he was designing engineer for Williams & Cole, consulting engineers. In 1916 he became assistant chief engineer of Parks Cramer Co., Fitchburg, Mass. and in 1931 he was associated with E. B. Badger and Sons Co., Boston. In 1946, he became design engineer for Buerkel & Co., Inc., Boston.

During his lifetime, Mr. Fitch was in charge of design and installation of heating and ventilating equipment for various buildings and plants, including the Bridgeport Hospital, Bridgeport, Conn., Stark Mills, Hogansville, Ga. and Ohio Valley General Hospital, Wheeling, W. Va.

HARLAN B. HINCKLEY

Harlan B. Hinckley, Chicago, Ill., died on April 30, 1949 at the age of 60.

Mr. Hinckley was born in Chicago in 1888 and attended the Armour Institute of Technology. In 1915 he became estimator and steamfitting foreman for C. E. Tandy, a Chicago contractor. From 1923 to the present he was employed by the Chicago Board of Education as engineer custodian, in charge of heating and ventilating operations of a public school.

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Heat Pump: R. C. Jordan, *Chairman;* E. R. Ambrose, R. D. Blum, C. F. Boester, C. W. Brown, W. F. Friend, M. C. Giannini*, C. F. Kayan, J. D. Kroeker, E. P. Palmatier, S. S. Sanford.

Heating Load: T. F. Rockwell, *Chairman;* R. A. Biggs, A. I. Brown, R. C. Cross*, R. S. Dill, W. S. Harris, J. M. Hartman, L. G. Miller, S. I. Rottmayer, M. W. Shears, G. H. Tuttle.

Human Calorimetry: G. L. Tuve, *Chairman;* E. F. DuBois, M.D., J. D. Hardy, M.D., E. R. Queer*, L. E. Seeley, C. P. Yaglou.

Industrial Ventilation: W. N. Witheridge, *Chairman;* A. D. Brandt, J. H. Clarke, W. C. L. Hemeon, W. O. Huebner, C. W. Johnson*, J. M. Kane, M. G. Kershaw, L. L. Lewis, G. E. McElroy, H. A. Mosher, B. F. Postman, K. E. Robinson, B. R. Small, W. M. Wallace, II, R. P. Warren, H. E. Ziel.

Insulation: E. R. Queer*, *Chairman;* R. E. Backstrom, C. B. Bradley, R. B. Crepps, M. W. Keyes, H. E. Lewis, H. E. Robinson, Vic Sanders, T. D. Stafford, L. V. Teesdale, R. K. Thulman, T. T. Tucker, P. M. Woodworth.

Odors: T. H. Urdahl*, *Chairman;* N. E. Berry, W. V. Consolazio, C. L. Fay, W. A. Grant*, E. P. Heckel, G. W. Meek, H. T. Porter, W. N. Witheridge.

Panel Heating and Cooling: P. B. Gordon, *Chairman;* A. B. Algren*, J. W. James*, J. S. Locke, S. K. Smith.

Group A—Heat Distribution Within and Behind the Panel: A. B. Algren*, *Chairman;* R. A. Biggs, R. S. Dill, H. L. Flodin, F. E. Giesecke, W. S. Harris, C. F. Kayan, G. D. Lain, R. L. Maher, C. W. Meininger, D. L. Mills, C. W. Nessell, P. S. Park, S. I. Rottmayer, E. E. Scott, S. K. Smith, R. K. Thulman, S. M. VanKirk, W. J. Widmer, G. L. Wiggs.

Group B—Heat Transfer Between the Panel and the Space: J. W. James*, *Chairman;* H. F. Randolph, *Vice Chairman;* C. M. Ashley, J. T. Bergen, C. F. Boester, Wharton Clay, Linn Helander, A. L. Jaros, H. A. Lockhart, W. E. Long, C. O. Mackey, R. A. Miller, G. W. Penney, G. G. Sward, J. M. van Nieukerken, H. E. Wheeler.

Group D—Controls: J. S. Locke, *Chairman;* H. W. Alyea, S. D. Browne, R. L. Campbell, C. M. Garner, P. B. Gordon, W. J. Hajek, A. J. Keating, W. H. Kliever, H. T. Kucera, P. F. Neess, J. K. M. Pryke, E. J. Ritchie, C. W. Signor, N. D. Skinner, A. S. Widdowfield.

Sensations of Comfort: C. S. Leopold, *Chairman;* Lester T. Avery, John Everetts, Jr., Nathaniel Glickman, W. A. Grant, E. J. Rodee.

Sorbents: John Everetts, Jr., *Chairman;* G. C. F. Asker, F. C. Dehler, A. S. Gates, Jr., M. C. Giannini*, E. R. McLaughlin, J. C. Patterson, G. L. Simpson, F. J. Swaney.

Sound Control: T. A. Walters, *Chairman;* C. M. Ashley, P. H. Geiger, Sidney Gordon, F. B. Holgate, G. C. Kerr, M. W. Keyes, R. D. Madison*, T. H. Troller, George Wohlberg.

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• MANITOBA: Organized 1935. Headquarters, Winnipeg, Man., Canada. Meets, Third Thursday. President, A. W. Moss, 268 Yale Ave., Winnipeg. Secretary, C. M. Fleming, 447 Main St., Winnipeg.

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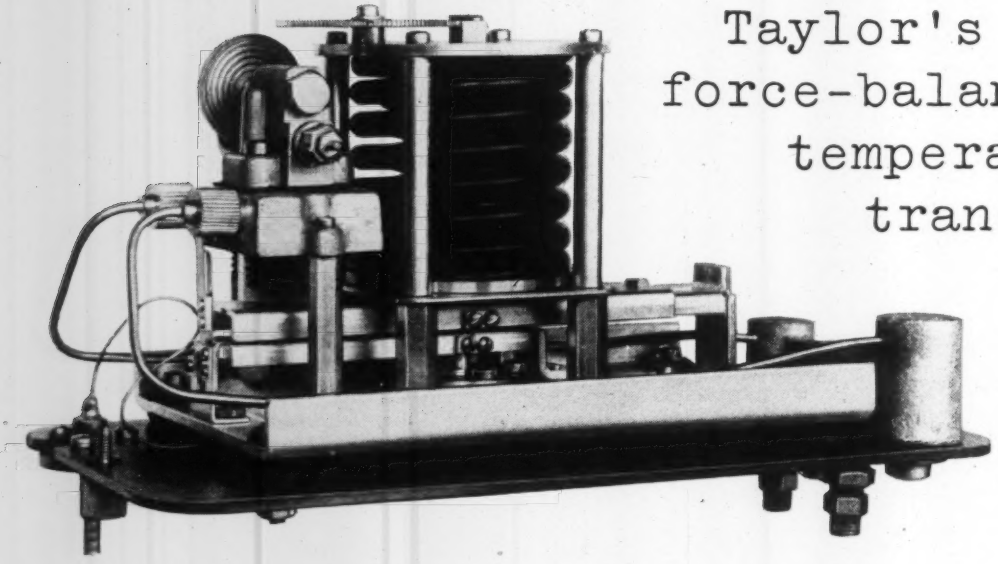

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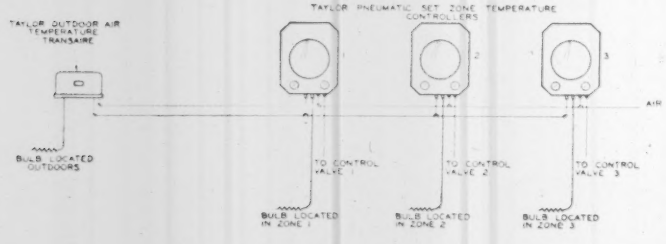
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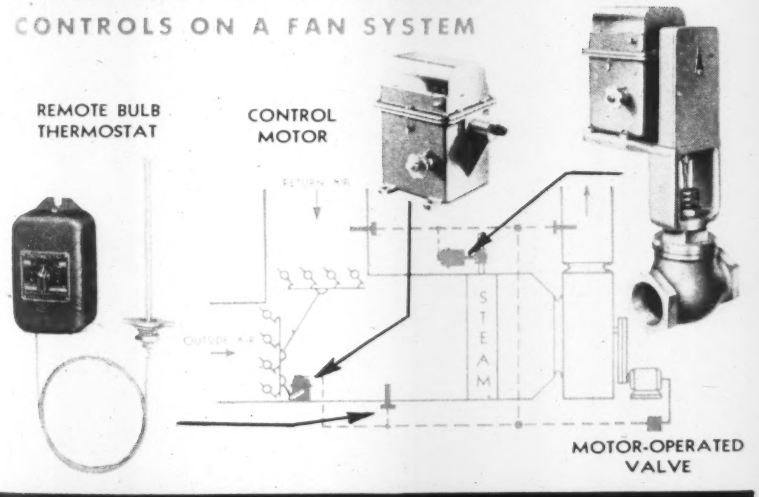

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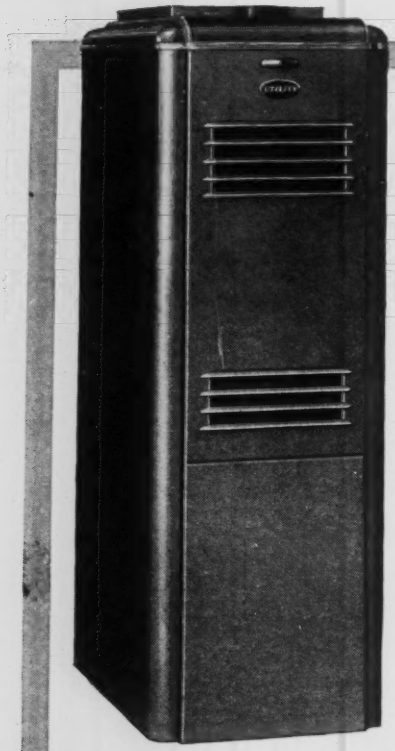

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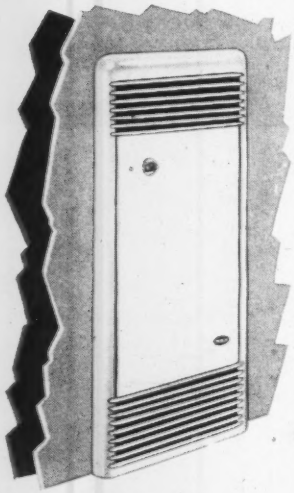
Single and Dual WALL HEATERS

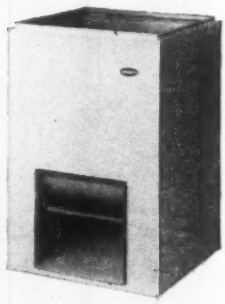
For every type of single and multiple-story structure. Pre-assembled with plaster guides and header for installing in any 4" wall without furring. 3 sizes—BTU range, 25,000 to 50,000.



UTILITY
appliance corp.
4853 S. Alameda St., Los Angeles 11, Calif.
DIVISIONS
Gaffers & Sattler • Occidental STOVE CO.

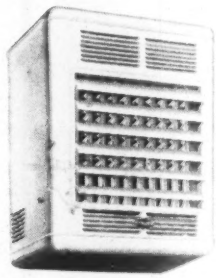
COMPLETE RANGE OF SIZES ★ PRICED TO SELL AGAINST TODAY'S COMPETITION

UTILITY



ALL-YEAR CONDITIONER
(Blower-Filter Package)

Dynamically balanced, high performance *Utility*-built blower, Fiberglas filters, variable pitch pulley, heavy steel cabinet. CFM ratings from 700 to 2600.

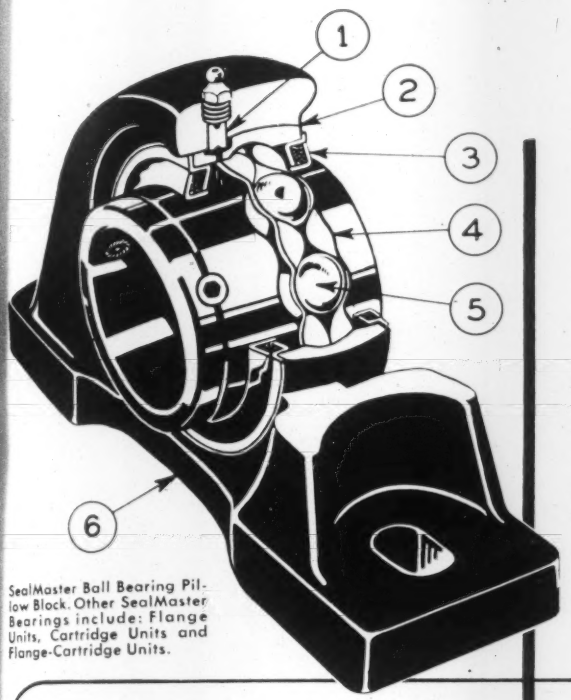


Suspended UNIT HEATERS

Completely self-contained. Quiet—slow speed, resilient base motor on streamline mounts. Individual burner for each element section prevents flame impingement. 4 sizes—BTU range, 60,000 to 225,000.

Design *Your* fans, blowers, and air-conditioning equipment to include SEALMASTER

BALL BEARING UNITS



SealMaster Ball Bearing Pillow Block. Other SealMaster Bearings include: Flange Units, Cartridge Units and Flange-Cartridge Units.

1. NO HOUSING WEAR!
Patented locking pin and dimple prevent rotation of outer race in housing, thus eliminating housing wear . . . permit shaft alignment and position unit for relubrication.

2. SELF-ALIGNING!
Bearing unit, with seals independent of housing, can align itself in any direction without seal distortion.

3. PERMANENTLY SEALED!
Felt-lined steel flinger rotating in labyrinth prevents entry of dirt and retains proper amount of lubricant.

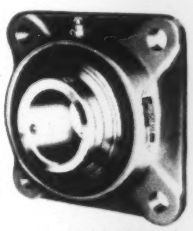
4. FLOATING RETAINER!
Ball retainer is designed to float on ground inner surface of outer race . . . traps lubricant and prevents churning.

5. PRE-LUBRICATED!
The bearing chamber is filled with the proper amount of grease before bearing leaves factory.

6. HOUSING DESIGN!
SealMaster's cast housings combine rigid one-piece construction with neat streamlined appearance.

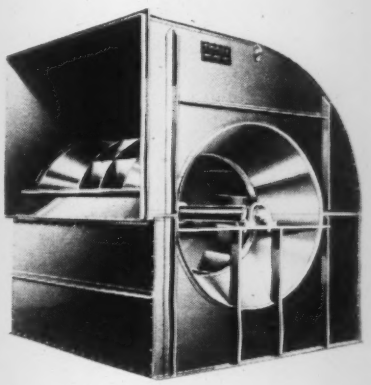
SILENCE Your Air-Conditioning Equipment with These SEALMASTER UNITS

4-BOLT BASE PILLOW BLOCK



FLANGE UNIT

STANDARD DUTY PILLOW BLOCK



A complete line of SealMaster pillow blocks, flange units and other types are available in a wide range of shaft sizes and for varying degrees of service. SealMaster units are designed and constructed to give top performance on all types of fans, blowers, pumps and other equipment in the air conditioning field. Include SealMaster bearings in your design and improve your product. Write us for a free copy of SealMaster catalog No. 845.

Climate changer unit for commercial and residential air conditioning uses SealMaster bearings for noise-free, dependable operation. Trane Company photograph.

BEARING DIVISION

STEPHEN S-A DAMSON MFG. CO.

47 RIDGEWAY AVENUE, AURORA, ILLINOIS · LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Factory Representatives and Dealers in All Principal Cities

TIME TO HOFFMANIZE !

... AND TAKE A PROFIT ON SLUGGISH RADIATORS

No 2A
VACUUM
3
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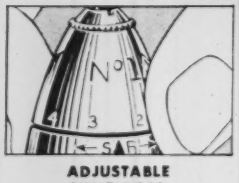
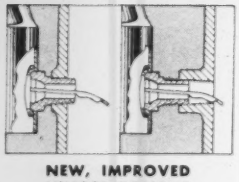
S
F
HOFFMAN SPECIALTY CO
INDIANAPOLIS IND
MADE IN USA
HAVE THESE VALVES IN YOUR STOCK FOR THE EARLY REPLACEMENT JOBS
No. 40 Radiator Non-vacuum Valve
No. 71A Convector Non-vacuum Valve
No. 75 Main Vent Non-vacuum Valve
No. 76 Main Vent Vacuum Valve
No. 1A Radiator Non-vacuum Valve, Adjustable Port
No. 70A Radiator Non-vacuum Valve
No. 74 Unit Heater Vent Valve
No. 79 Hot Water Vent Valve
No. 2A Radiator Vacuum Valve, Adjustable Port



ADJUSTABLE VENT PORT

Comparative tests show the Hoffman vent port adjustment to provide a smoothly graduated rate of venting in direct proportion to the size of the opening. Adjustable to prevent waterlogging, spitting and rumbling caused by too fast venting.



NEW, IMPROVED HINGED TONGUE

Diagrams above show how Hoffman Double-Capillary action, hinged drainage Tongue construction adapts itself to radiators equipped with various boss lengths. It assures good drainage under all conditions of service. An exclusive Hoffman feature.

Again it's time to modernize millions of air-bound, stubborn radiators and harvest quick profits on a turnover of Hoffman Vent Valves. For, in *guarding comfort and fuel,* the first step is **proper venting** . . . a function Hoffman Valves are famous for, backed by nearly forty years of specialized experience, exclusive features and precision workmanship. There is a Hoffman Valve for every need—radiators, convectors, unit heaters, main vent valves for steam and hot water heating systems.

The heating season is right ahead . . . it's time to order the Hoffman Valves you'll need for early modernizing jobs. For complete information on Hoffman Radiator and Main Vents, contact your wholesaler, or write

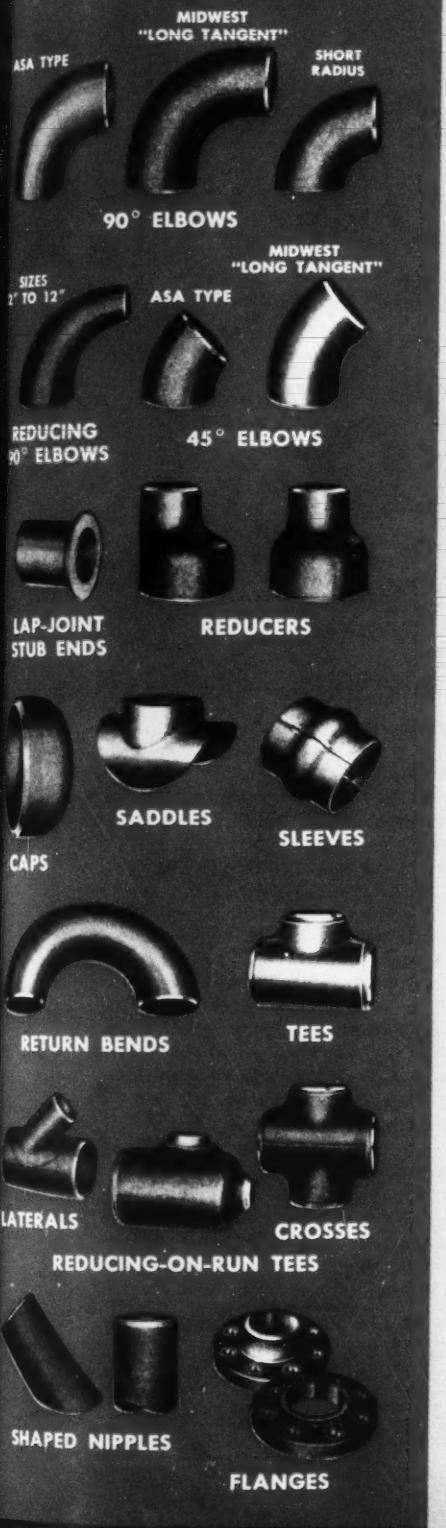
HOFFMAN SPECIALTY COMPANY
1001 York St., Dept. FG-7, Indianapolis 7, Ind.

Makers of Valves, Traps, Hot Water Heating Systems, Vacuum and Condensation Pumps . . . Sold by Leading Wholesalers of Heating and Plumbing Equipment.

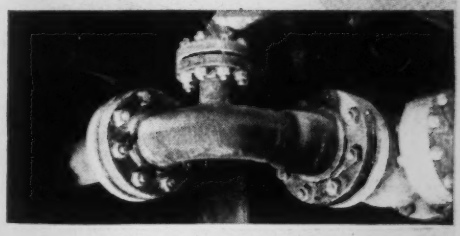
HOFFMAN VENT VALVES

Controlled Heating

MIDWEST WELDING FITTINGS
Improve Piping Designs and Reduce Costs



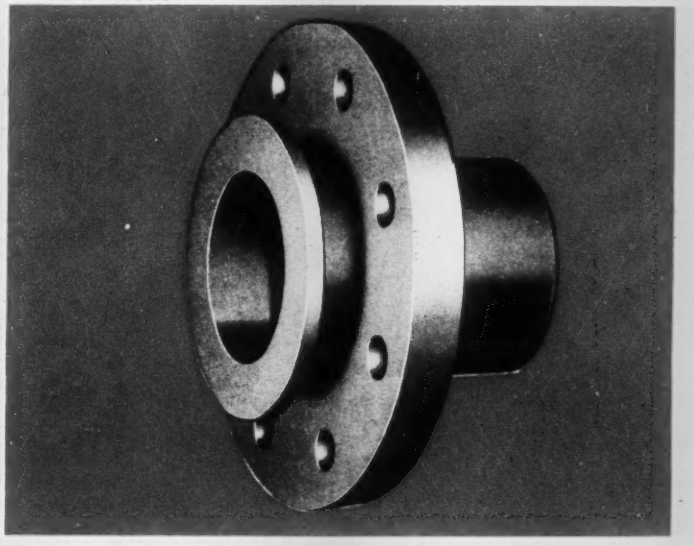
IN WELDED PIPING SYSTEMS



SAVE TIME and MONEY on EQUIPMENT CONNECTIONS

by using MIDWEST

LAP JOINT STUB ENDS



Substantial savings of time and money result if Midwest Lap Joint Stub Ends are used when making connections to valves, equipment or other flanged outlets in welded piping systems. They have important advantages over flanges welded to the pipe.

The swivel flange makes it unnecessary to line up the bolt holes before welding. Setting up is quick and simple because no special clamps or jigs are required to hold the face of the flange absolutely perpendicular to the axis of the pipe. Field crews report as high as 25% saving in erection time for making up a joint using Midwest Lap Joint Stub Ends in comparison with rigidly fixed flanges.

Midwest Welding Fittings improve piping—save money. Get in touch with the distributor near you.

3719

MIDWEST PIPING & SUPPLY COMPANY, Inc.

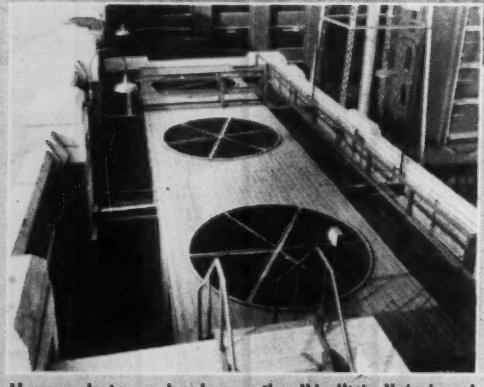
Main Offices: 1450 South Second Street, St. Louis (4), Mo.
***Sales Offices:* New York (7), 30 Church St.**
Chicago (3), 79 West Monroe St. • Los Angeles (33), 520 Anderson St. • Houston (2), 229 Shell Bldg. • Tulsa (3), 533 Mayo Bldg. • South Boston (27), 426 First St. • Distributors in Principal Cities.

Where's the Cooling Tower?

Where's the Cooling Tower?

Where's the Cooling Tower?

WHERE'S the COOLING TOWER in this photo?



Upper photograph shows the "built-in," induced draft cooling tower. The lower insert is a close-up view of the propeller fans and fan guards hidden from ground level view by the coping on building.

A Beautiful Air Conditioned Building

But Where's the Cooling Tower?

That's right, where's the cooling tower? So effective has been the outer construction of this C. H. Wheeler water cooling tower, that it is in complete harmony with the appearance of the building in which it is housed and is hardly noticeable. Actually, the tower is located in the foreground of the photograph and the air inlet louvres can be seen where they give a venetian blind appearance in space ordinarily allowed for windows. As engineers and builders of cooling towers, it is conceded that most are not a thing of beauty, but where appearance is important, the casing can be made to blend with other buildings like this one—whether it be brick, stone or masonry.

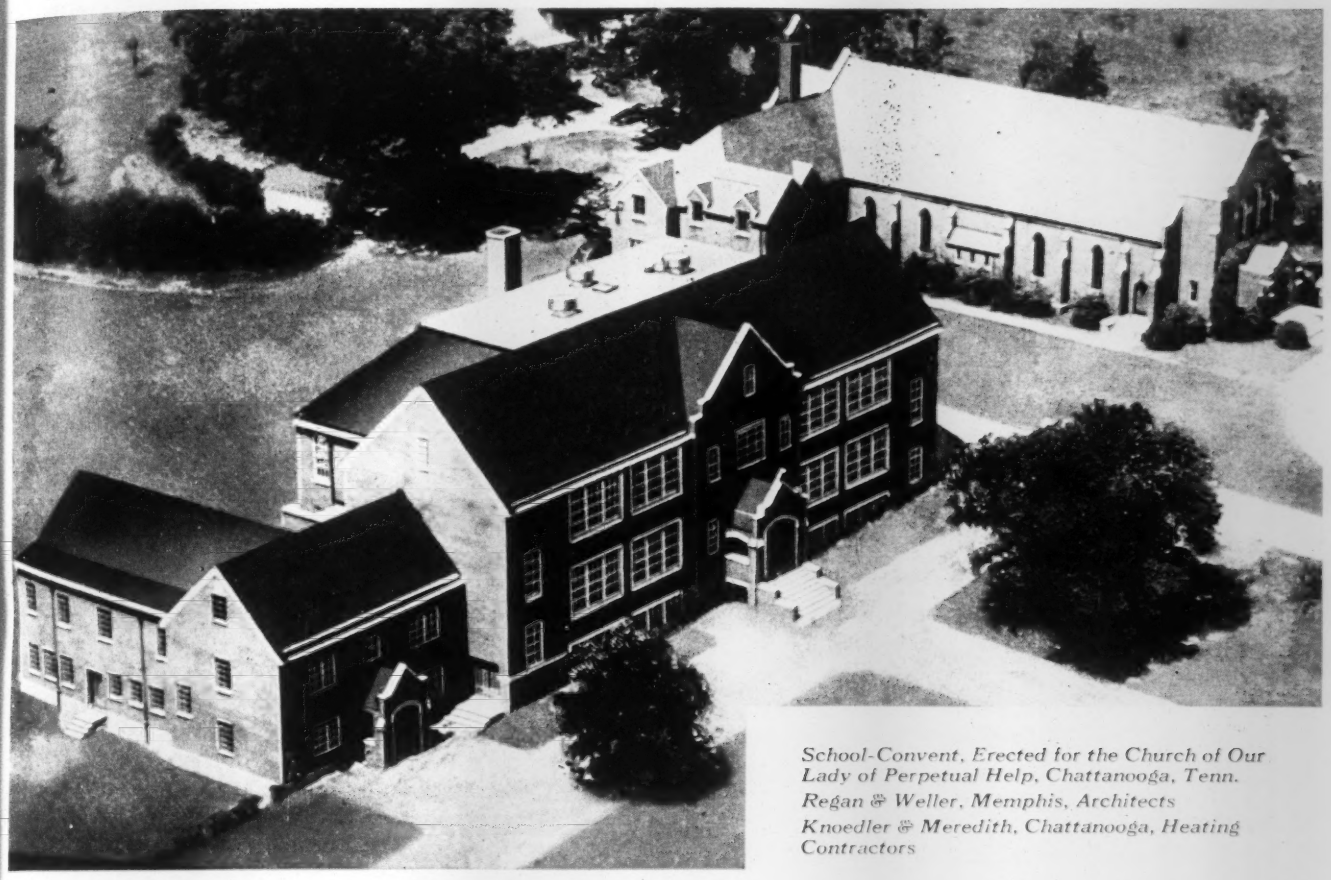
In air conditioning systems for large buildings, C. H. Wheeler towers effectively cool for recirculation whatever volume of water is needed to dissipate the heat absorbed by the refrigerant. Furthermore, only a small amount of make-up water is required to compensate for drift and evaporation losses. Wide acceptance of C. H. Wheeler towers for this service is based on guaranteed water cooling performance, and the fact that C. H. Wheeler engineers especially design and custom build every tower to meet the varying cooled water requirements of any air conditioning system. For a cooling tower of lasting satisfaction and guaranteed performance, consult C. H. Wheeler. Write for Catalog No. 145.

C. H. WHEELER MANUFACTURING CO.
1826 Sedgley Avenue, Philadelphia 32, Penna.
REPRESENTATIVES IN MOST PRINCIPAL CITIES

SINCE 1903

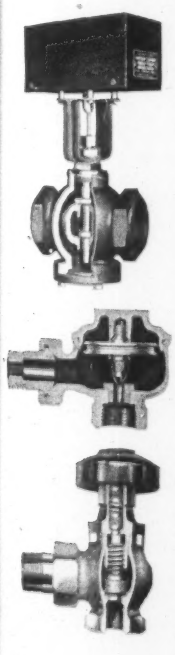
C. H. Wheeler

STEAM CONDENSERS • WATER COOLING TOWERS
EJECTORS • STEAM JET VACUUM REFRIGERATION
OF PHILADELPHIA



School-Convent, Erected for the Church of Our Lady of Perpetual Help, Chattanooga, Tenn.
Regan & Weller, Memphis, Architects
Knoedler & Meredith, Chattanooga, Heating Contractors

An ILLINOIS *Automatic*
Cycling Flow Control System Type E



assures maximum fuel economy, comfort and convenience in this new School-Convent building.

Steam is generated by a stoker-fired steel boiler and distributed to approximately 80 units of radiation. The system is divided into two main heating zones. In each zone the flow of steam is controlled by ILLINOIS Motorized Valves Type E, operated by Outdoor-Indoor Combination Temperature Controllers. All condensate from radiation and piping gravitates to a motor-driven vacuum pump which returns the condensate to the boiler.

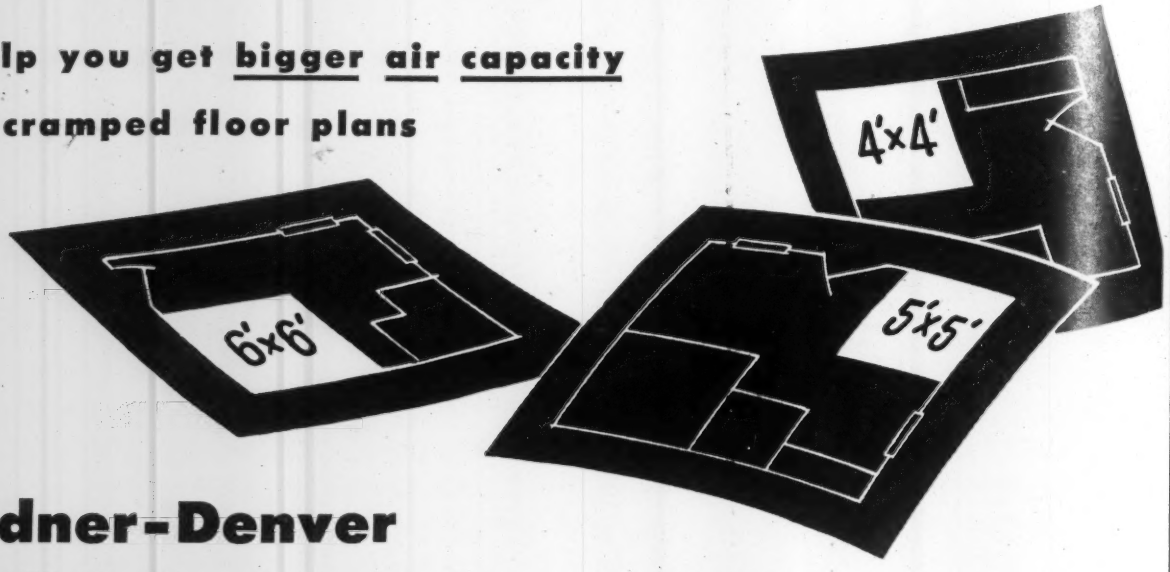
The entire system of piping and radiation is ILLINOIS equipped — Radiator Traps, Valves, and Float and Thermostatic Traps — thus assuring efficient and rapid steam circulation.

Other ILLINOIS Heating Systems include Type A Continuous Flow Control and Type C Generation Control, as well as the standard Vacuum and Vapor Systems.

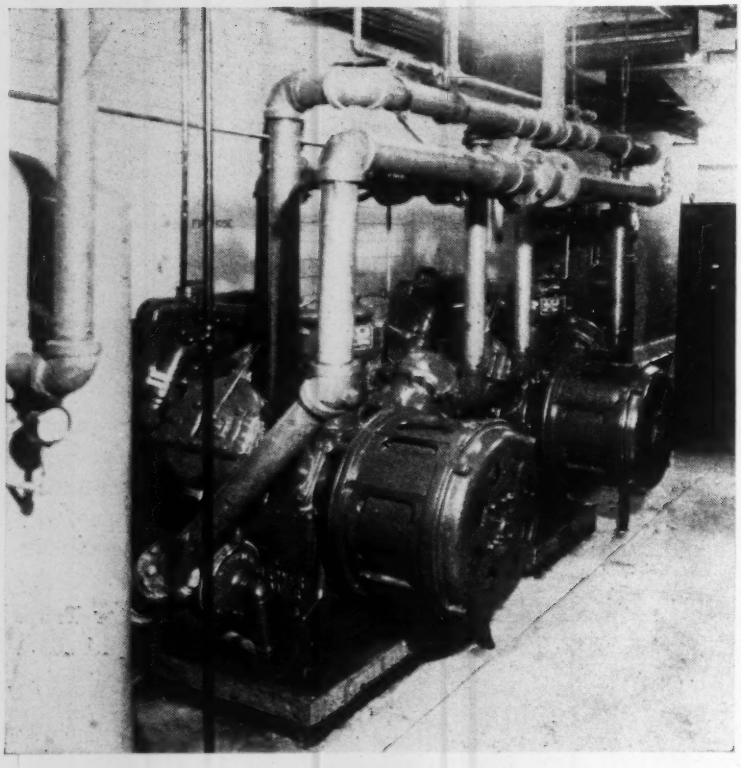
Write for Bulletins

ILLINOIS ENGINEERING COMPANY
INCORPORATED 1900
RACINE AVENUE AT 21ST STREET • CHICAGO 8

To help you get bigger air capacity from cramped floor plans



Gardner-Denver "WB" Compressors are made in 7 sizes!



Compact Gardner-Denver "WB" Two-Stage, Vertical Water-Cooled Compressors, with built-in motors.

Here's how you can have *greater air capacity* — even though floor plans are crowded! Install a Gardner-Denver "WB" — the vertical, two-stage compressor that's built in seven space-saving capacities from 142 to 686 cubic feet displacement per minute. The smallest size fits into a four-foot square — the largest requires only about six feet each way.

Compactly designed with integral motor and self-contained cooling system, the "WB" rates high in efficiency. Completely water-jacketed cylinders and heads, plus balanced construction — two low pressure cylinders for each high pressure cylinder — assure low power costs and an air supply you can always count on.

Other big "WB" advantages:

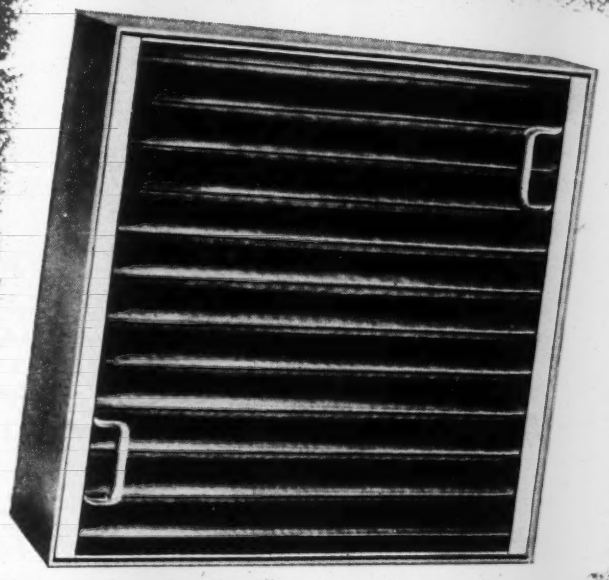
- ★ Duo-Plate "air-cushioned" valves — quiet, simple and durable.
- ★ Timken tapered roller main bearings.
- ★ Force-feed lubrication system.
- ★ Furnished with built-in motor — or with sheave for "V"-belt drive.

For complete information, write Gardner-Denver Company, Quincy, Illinois.

In Canada: Gardner-Denver Company (Canada) Ltd., Toronto, Ontario

GARDNER-DENVER SINCE 1859

Cut air conditioning costs this new, easy way...



Air purification simplified. "C" Cells measure only 24" x 24" x 8¾". Require no more engineering than dust filters; can be mounted right with them.

DOREX announces amazing new "C" cell!

The new "C" Cell makes it easy to keep a building filled with fresh, invigorating air and cut your conditioning cost at the same time. It maintains the *natural* freshness of air by completely removing all of the odors that make it stale and stuffy. By changing used air to fresh air, Dorex Equipment cuts air conditioning costs because it enables you to recirculate more of the air that is already conditioned, instead of throwing it away because it is stale and odorous. That means less outdoor air to heat or cool, less equipment, and smaller operating expenses. For instance, each "C" Cell, in converting 1000 cubic feet per minute of used air to fresh air, saves approximately 2.5 tons of installed refrigeration, 1½ KW per hour during the cooling season or ½ gallon of fuel oil per hour during the heating season.

Compact, easy to install and maintain

"C" Cells require practically no engineering. Each cell, measuring ony 24" x 24" x 8¾", completely purifies 1000 cfm of recirculated air. "C" Cells can be installed like dust filters in either a flat or V arrangement. All steel parts are precision die-stamped for uniform, accurate assembly, and the cell is filled with highly activated carbon for positive odor and vapor removal. Resistance to air flow does not exceed 0.15 wg., and maintenance is held to a minimum.

If you are designing, using or remodeling an air conditioning system, this bulletin may point the way to definite savings for you or your client. Send for your copy now while the coupon is handy.

W. B. CONNOR ENGINEERING CORP.
Air Diffusion • Air Purification • Air Recovery
112 East 32nd Street CONNOR New York 16, N.Y.
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I'm interested in saving money on air conditioning.
Please send me Bulletin 117C.

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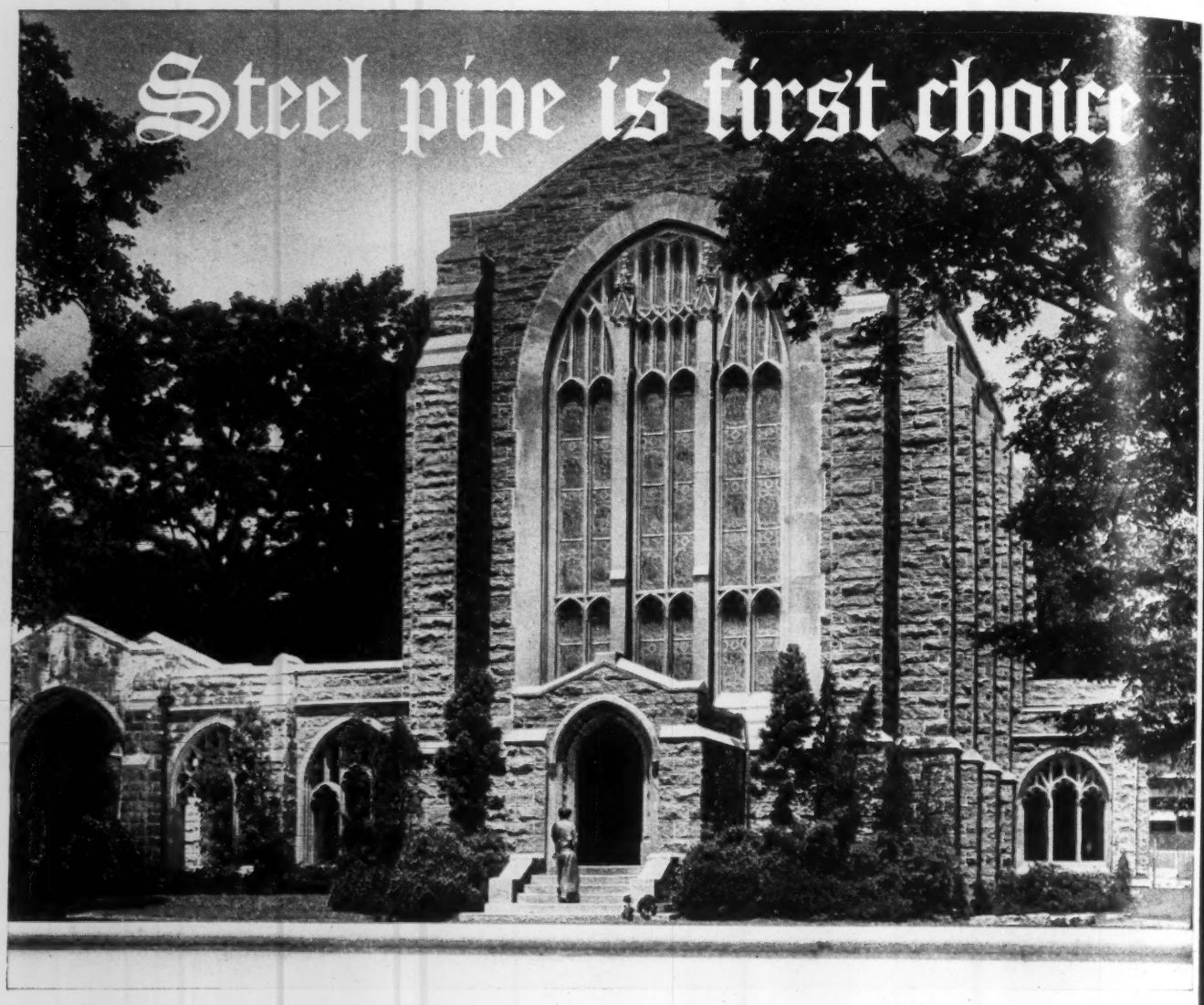
Steel pipe is first choice



for the churches of America

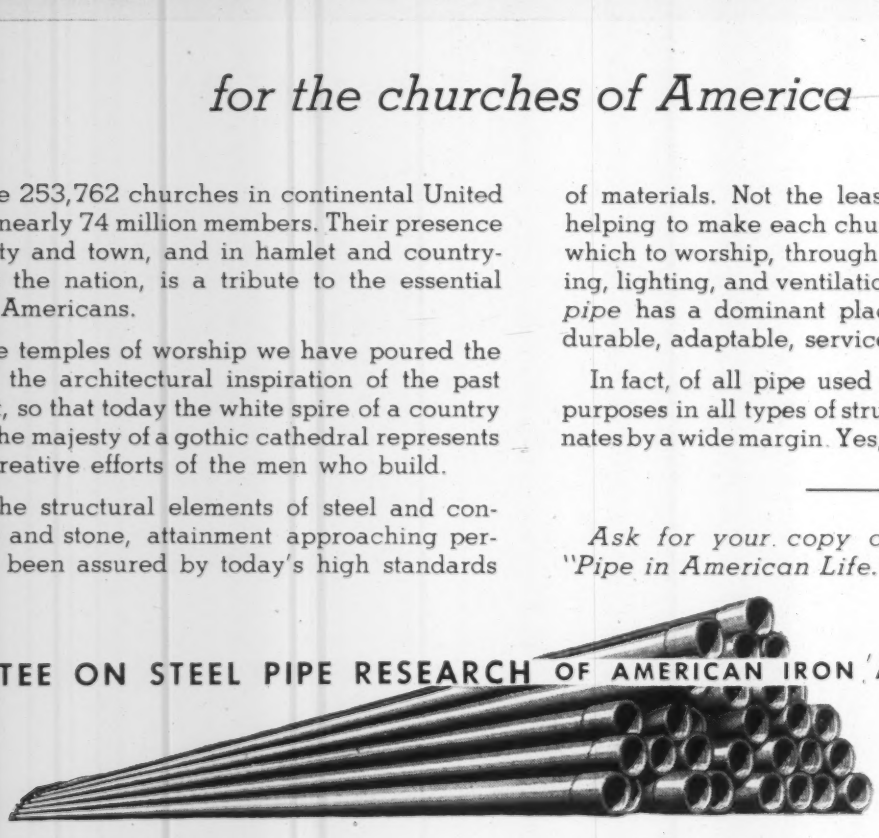
There are 253,762 churches in continental United States with nearly 74 million members. Their presence in every city and town, and in hamlet and countryside across the nation, is a tribute to the essential morality of Americans.

Into these temples of worship we have poured the richness of the architectural inspiration of the past and present, so that today the white spire of a country church or the majesty of a gothic cathedral represents the finest creative efforts of the men who build.

Beyond the structural elements of steel and concrete, brick and stone, attainment approaching perfection has been assured by today's high standards of materials. Not the least of these is *steel pipe*, helping to make each church a comfortable place in which to worship, through adequate heating, plumbing, lighting, and ventilation. For these services *steel pipe* has a dominant place because *steel pipe* is durable, adaptable, serviceable, and economical.

In fact, of all pipe used for plumbing and heating purposes in all types of structures, steel pipe predominates by a wide margin. Yes, *steel pipe is first choice!*

Ask for your copy of the interesting story "Pipe in American Life."



COMMITTEE ON STEEL PIPE RESEARCH OF AMERICAN IRON AND STEEL INSTITUTE

350 Fifth Avenue
New York 7, N. Y.

Can you afford to waste what IRON FIREMAN users are saving?

Iron Fireman Stoker cuts labor costs in half, handles greater heating load with same tonnage!

Iron Fireman cuts costs 5 ways

1. Burns economical stoker coal. **2.** Exclusive Air Volumeter maintains correct fuel-air ratio, regardless of load, for most efficient combustion—more heat utilized from each pound of coal. **3.** Follows load closely, using coal only as needed. No wasteful lag or over-run. **4.** No coal handling required. Fireman has time for other duties. **5.** Moving parts located away from damaging heat, reducing service and replacement costs.

What about YOUR heating costs?

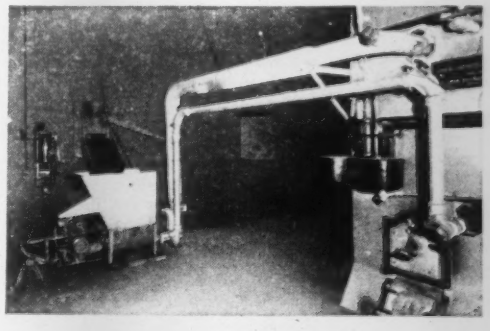
An Iron Fireman technical man will be glad to make a survey of your present heating plant and render a report showing what savings and improvements you could make with an Iron Fireman. Write today for free literature. Iron Fireman Mfg. Co., 3135 W. 106th St., Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Ontario. Dealers everywhere.

JEFFERSON HOTEL, Richmond, Va.

A typical example of Iron Fireman economy is The Jefferson Hotel, Richmond, Va., which installed a Pneumatic Spreader Stoker in 1944.

Mr. A. Gerald Bush, Manager, states that although space and percentage of occupancy have been increased 35% to 50% since installation, there has been no appreciable increase in the amount of fuel consumed. Mr. Bush also states that labor costs in the boiler room have been cut in half, and that smoke nuisance has been abated.

Incidentally, this is the fourth Iron Fireman stoker that Mr. Bush has had installed in different hotels during the past 16 years.



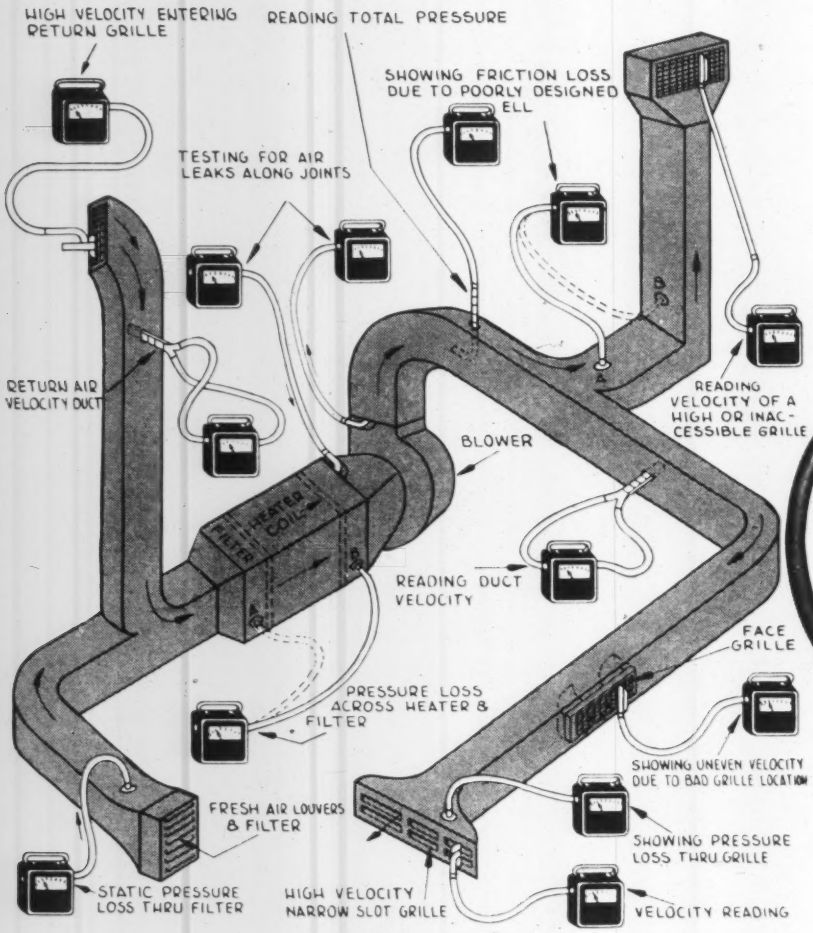
Pneumatic Spreader Stoker firing 150 h.p. Union Iron Works boiler at 100 lbs. gauge in boiler room of Jefferson Hotel. Steam size coal is metered from hopper (or main bunker in Coal-Flow models) and is transferred by pneumatic conveyor to furnace. Conveyor nozzle accurately spreads larger particles of coal over entire grate in a shallow, uniform fuel bed. Preheated fines burn in suspension, reducing cinder carry-over and greatly improving combustion efficiency and responsiveness, as compared with stokers which do not preheat coal.

IRON FIREMAN

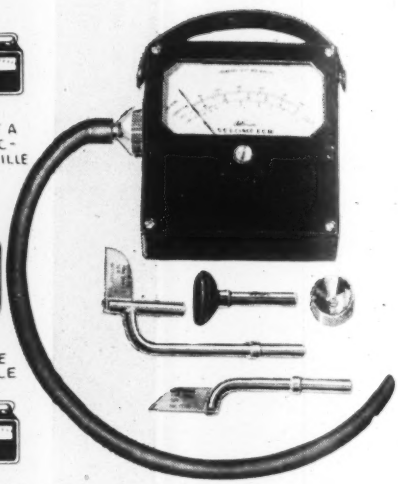
THE IRON FIREMAN

Automatic Firing Equipment for GAS · OIL · COAL

For a balanced system . . . .


HIGH VELOCITY ENTERING RETURN GRILLE
READING TOTAL PRESSURE
SHOWING FRICTION LOSS DUE TO POORLY DESIGNED ELL
TESTING FOR AIR LEAKS ALONG JOINTS
RETURN AIR VELOCITY DUCT
READING VELOCITY OF A HIGH OR INACCESSIBLE GRILLE
BLOWER
HEATER COIL
FILTER
READING DUCT VELOCITY
FACE GRILLE
PRESSURE LOSS ACROSS HEATER & FILTER
SHOWING UNEVEN VELOCITY DUE TO BAD GRILLE LOCATION
FRESH AIR LOUVERS & FILTER
SHOWING PRESSURE LOSS THRU GRILLE
STATIC PRESSURE LOSS THRU FILTER
HIGH VELOCITY NARROW SLOT GRILLE
VELOCITY READING

TYPE 4-F *Standard minimum set for heating and air conditioning air velocity measurements.*



Use the instant direct-reading *Alnor* VELOMETER!

The type 4-F Velometer—especially designed for balancing a ventilating system. Furnished with standard jets, as illustrated—complete with carrying case and instructions. It will quickly pay for itself in convenience, accuracy and greater speed.

A LOOK at this drawing and you'll get an idea of the wide usefulness of the Alnor Velometer. For checking and maintaining old systems—and for help in making new installations—the Velometer is an all but indispensable instrument. It is the *only* instantaneous direct reading air velocity meter! No charts or calculations required—it's easy to understand, easy to use. As it has for thousands, it can simplify and speed up all your air conditioning and ventilating work.

Only $82.50 f.o.b., Chicago • USE THIS COUPON!

Illinois Testing Laboratories, Inc.
Room 513, 420 North La Salle St., Chicago 10, Illinois

☐ Send me a copy of Bulletin No. 2448-G
☐ Send me ___ Velometers at $82.50 each. (Enclose check, money order, or purchase order.)

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Company Name _____
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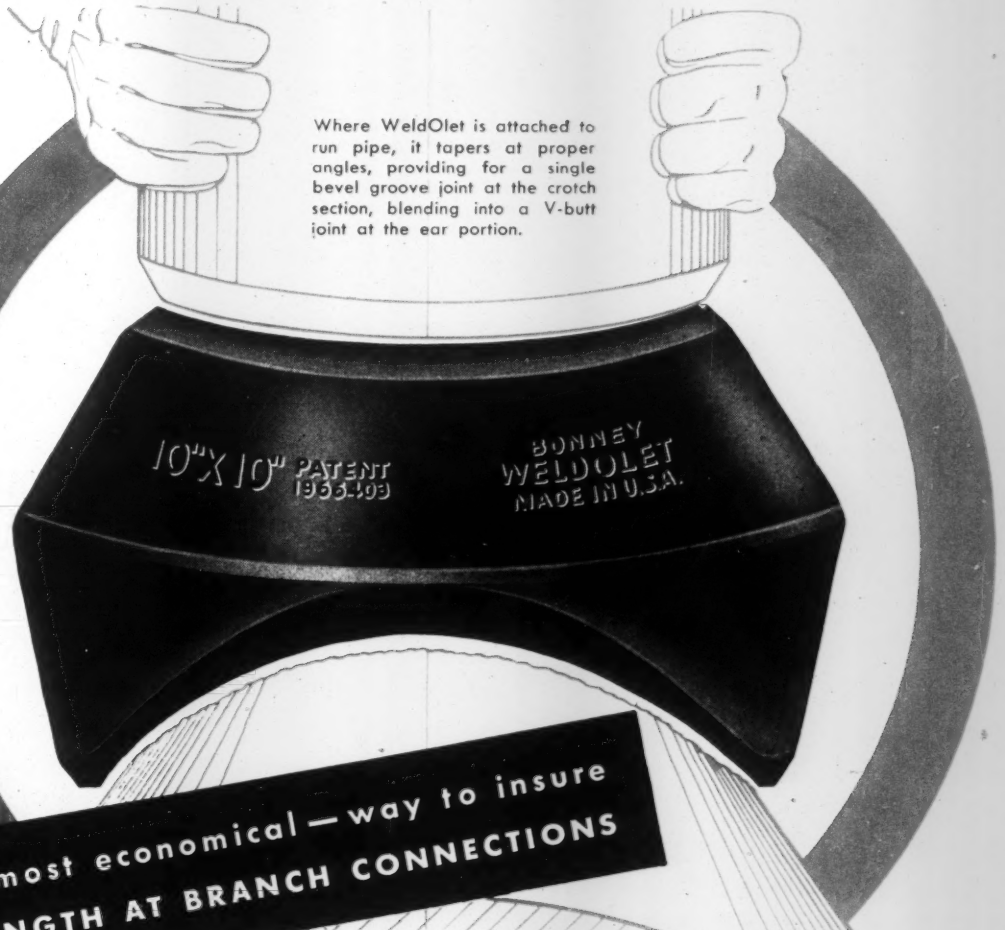
Alnor **PRECISION INSTRUMENTS FOR EVERY INDUSTRY**

ILLINOIS TESTING LABORATORIES, INC.
Chicago 10, Illinois



Where WeldOlet is attached to run pipe, it tapers at proper angles, providing for a single bevel groove joint at the crotch section, blending into a V-butt joint at the ear portion.

The quickest — most economical — way to insure FULL PIPE STRENGTH AT BRANCH CONNECTIONS

WeldOlets*, with outlet sizes from ⅛" to 24", both straight and reducing, need no additional reinforcement to establish and fully maintain original strength on ASTM A-106 Seamless Steel Grade A Pipe, as set forth in Code for Pressure Piping, American Standards Association, B31.1-1942, and Supp. No. 2, B31.1b-1947. WeldOlet welding fittings provide the quickest, most economical, most *satisfactory* method of obtaining *full pipe strength* at branch connections. For detailed engineering reference data, write for Catalog W-2.

BONNEY FORGE & TOOL WORKS

FORGED FITTINGS DIVISION • 350 GREEN STREET • ALLENTOWN, PENNA.

Authorized Canadian Factory Representative: Sterling Steel Co., Ltd., 20 Temperance St., Toronto 1, Canada—1040 Sherbrook St., W., Montreal, Canada

MANUFACTURERS OF FAMOUS BONNEY TOOLS

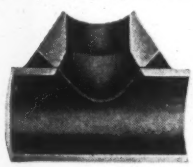


Fig. 1—Cut-away view of reducing size WeldOlet with welding outlet in place. The external rib and wide bases or footings of WeldOlets* eliminate the need for *extra supports* to take care of bending or vibrational stresses at crotch section, the point of greatest stress.

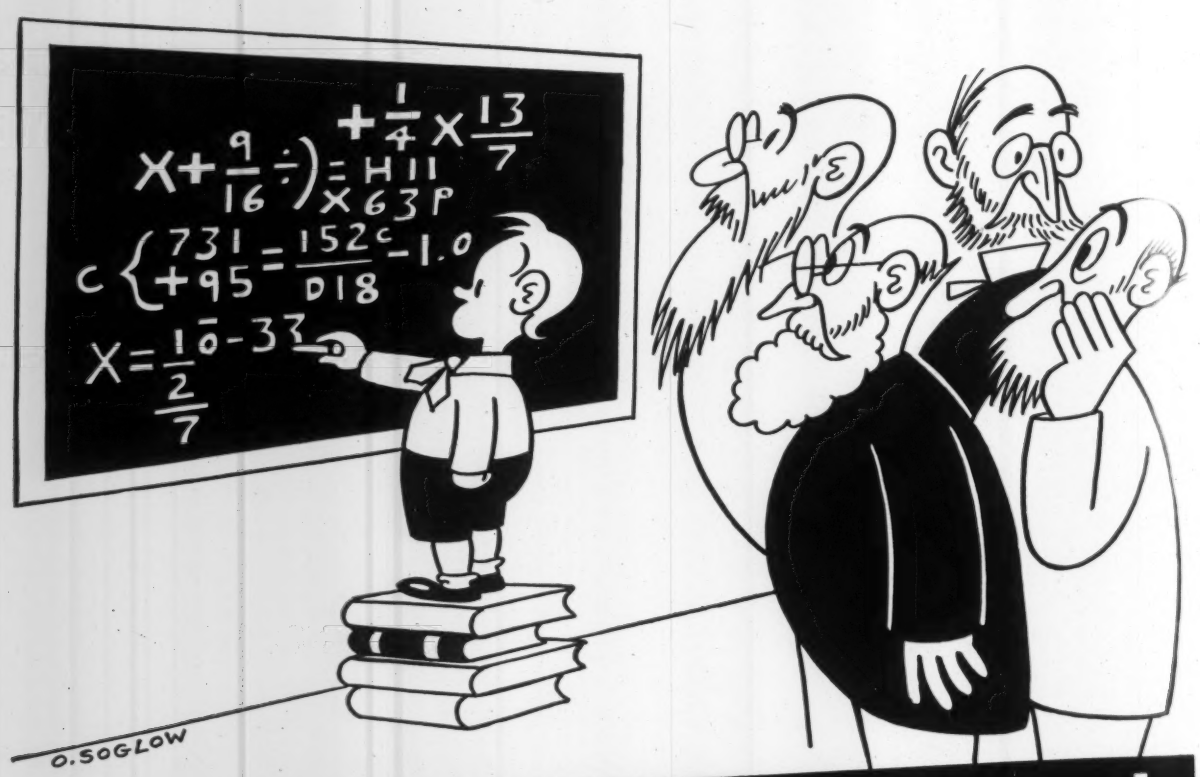
Fig. 2—Note blending of ear portion of welding fitting to run pipe. Extension of weld metal below inside scarfed portion of pipe insures all sections of joint greater than pipe wall thickness.

WELDOLETS

*Trade Mark Reg. U.S. Pat. Off. Pat. in U.S. & Foreign Countries

FOR WELDED BRANCH PIPE OUTLETS

When you want Bonney Welding Outlets, ask for WeldOlets*



You'll be surprised at these figures!

- 80 million Americans own $48 billion of U. S. Savings Bonds.
- 20,000 of the nation's 38,000 firms employing 100 or more persons are operating Payroll Savings Plans.
- 7,500,000 workers are buying an individual average of $20 of Bonds per month.
- For the year 1948, sales of Series E Bonds *exceeded redemptions* by $495,148,000. The net figure for all Series after redemptions and maturities was $2,151,140,000.

What does all this mean to you? Well, it means first of all that your Treasury Department is successful in its program of increasing the nation's economic security by spreading the national debt. Secondly it means that most of the nation's business leaders recognize the value of the Payroll Savings Plan sufficiently to promote it within their companies.

For example...

To give you some idea of the Plan's growing popularity: 86,384 employees of a prominent electrical manufacturing company were investing in Bonds at the rate of $30,005,270 as of the end of 1948. This is a gain of nearly 100% over 1947, when 45,000 employees participated in that company. The treasurer of a well-known shoe company reported that, of his concern's 19,060 employees, 9,240 were in the Plan and had invested $146,807.32 in Bonds via deductions during the preceding month.

Why promote it?

We all know how buying Bonds builds an individual's future security. But there are *company* benefits too! Nation-wide experience shows that Payroll Savings increases each participating employee's peace of mind—makes him a more contented, more productive worker. It reduces absenteeism, lowers accident rates, increases output, and improves employee-employer relations.

It's easy to boost participation

1. See that a top management man sponsors the Plan.

2. Secure the help of the employee organizations in promoting it.

3. Adequately use posters and leaflets and run stories and editorials in company publications to inform employees of the Plan's benefits to them.

4. Make a person-to-person canvass, once a year, to sign up participants.

These first four steps should win you 40-60% participation. Normal employee turnover necessitates one more step:

5. Urge each new employee, at the time he is hired, to sign up.

Nation-wide experience indicates that 50% of your employees can be persuaded to join—without high-pressure selling. All the help you need is available from your State Director, U. S. Treasury Department, Savings Bond Division.

The Treasury Department acknowledges with appreciation the publication of this message by

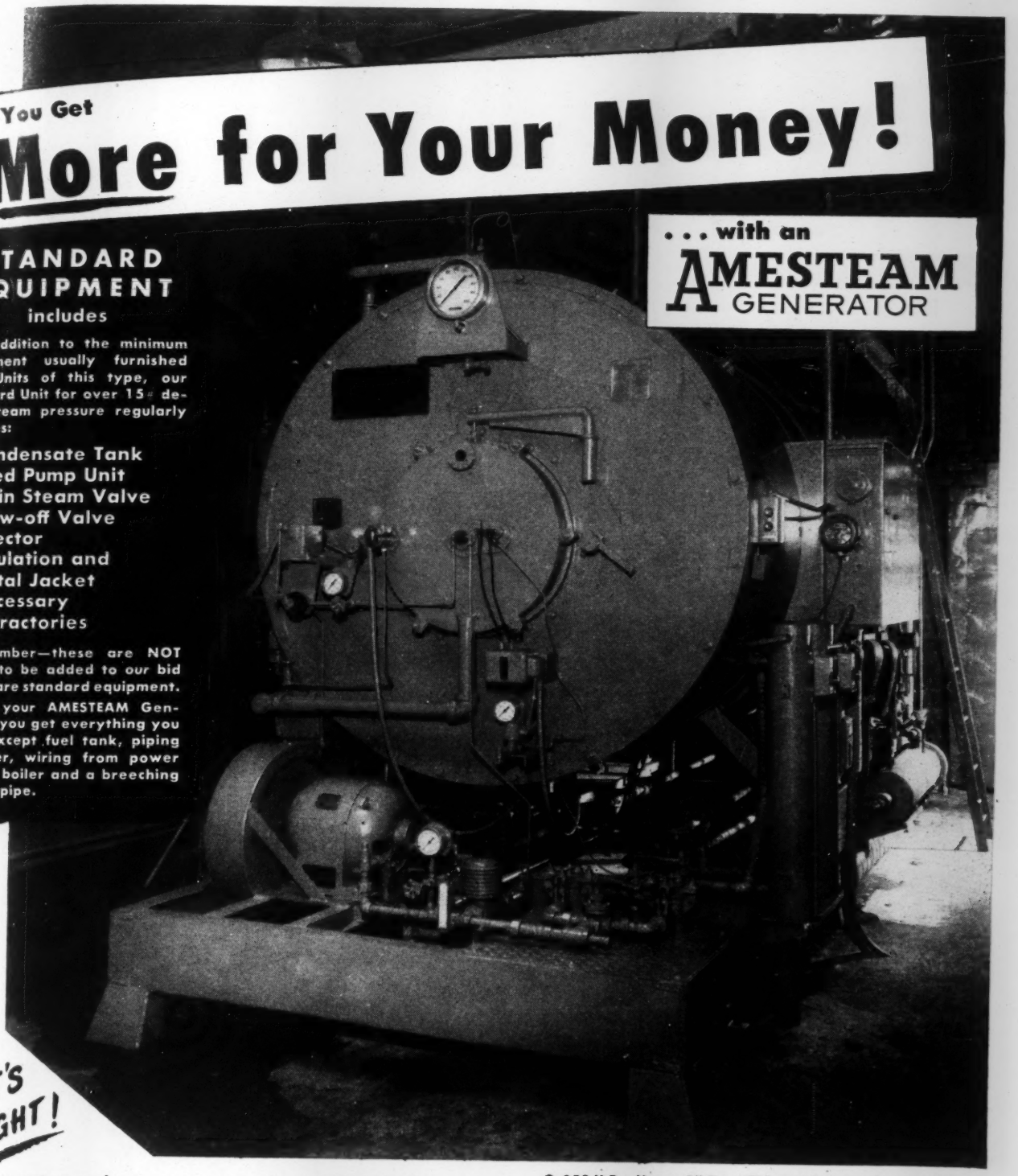
HEATING PIPING & AIR CONDITIONING

This is an official U. S. Treasury advertisement prepared under the auspices of the Treasury Department and The Advertising Council.

You Get

More for Your Money!

. . . with an AMESTEAM GENERATOR



STANDARD EQUIPMENT includes

In addition to the minimum equipment usually furnished with Units of this type, our standard Unit for over 15# design steam pressure regularly includes:

- Condensate Tank
- Feed Pump Unit
- Main Steam Valve
- Blow-off Valve
- Injector
- Insulation and
- Metal Jacket
- Necessary
- Refractories

Remember—these are **NOT** extras to be added to our bid—they are standard equipment.

With your AMESTEAM Generator, you get everything you need except fuel tank, piping to boiler, wiring from power lines to boiler and a breeching or vent pipe.

THAT'S RIGHT!

You get more for your money with an AMESTEAM Generator. When you buy this modern, fully automatic Unit it is complete in every respect. Connect your steam, water, fuel and electric lines, and your breeching or vent pipe, and you are ready for safe, economical operation.

Standard Units are available from 10 HP to 300 HP, for pressures from 15 lbs. to 200 lbs., for firing with Oil, Gas or Oil-Gas Combinations. Why not look into the money-saving possibilities of AMESTEAM Generators?

AMES IRON WORKS, Oswego, N. Y.

SEND IN THE COUPON TODAY!

● **250 H.P.—Heavy Oil Fired. This satisfied customer may be in your area. Write us for particulars.**

AMES IRON WORKS
Box 1607, Oswego, N. Y., U.S.A.

I would like to know more about AMESTEAM Generators. Please send bulletin.

Name.....

Company.....

Address.....

City.....**Zone**.....**State**.....

Kind of business.....

Estimated capacity needed.....

UNIVERSITY OF MICHIGAN LIBRARIES

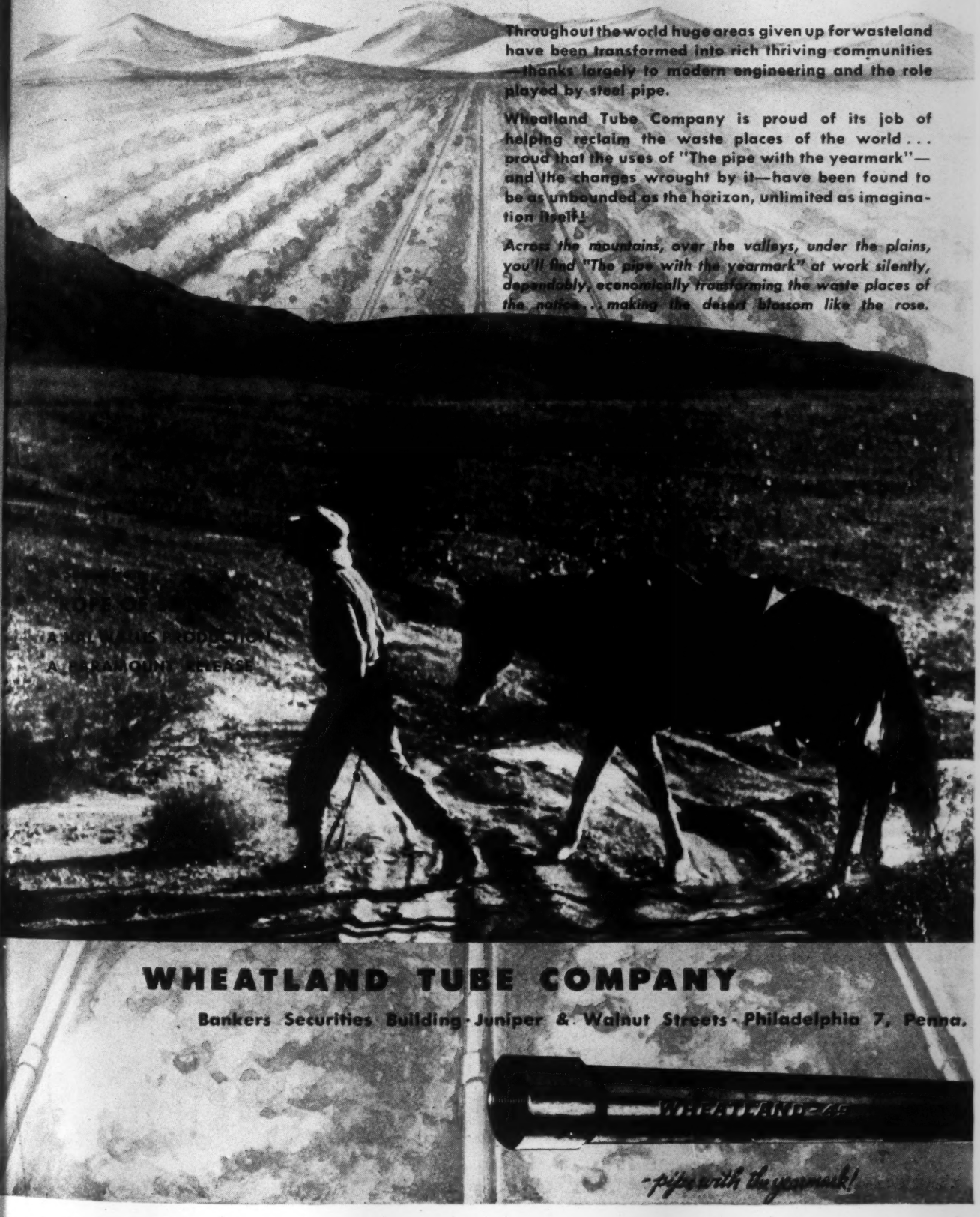
- COMPACT - SIMPLE - RUGGED
- WELL-BALANCED ENGINEERED DESIGN WITH BUILT-IN INHERENT STABILITY
- FORCE BALANCE TYPE OF POSITIONER
- AVAILABLE WITH AND WITHOUT BY-PASS
- USEABLE AS REMOTE POSITION INDICATOR

FOR COMPLETE SPECIFICATIONS AND DETAILS, WRITE FOR FISHER BULLETIN E-3500.

FISHER GOVERNOR CO., Marshalltown, Iowa

Wheatland STEEL PIPE...

magician of growth



Throughout the world huge areas given up for wasteland have been transformed into rich thriving communities—thanks largely to modern engineering and the role played by steel pipe.

Wheatland Tube Company is proud of its job of helping reclaim the waste places of the world . . . proud that the uses of "The pipe with the yearmark"—and the changes wrought by it—have been found to be as unbounded as the horizon, unlimited as imagination itself!

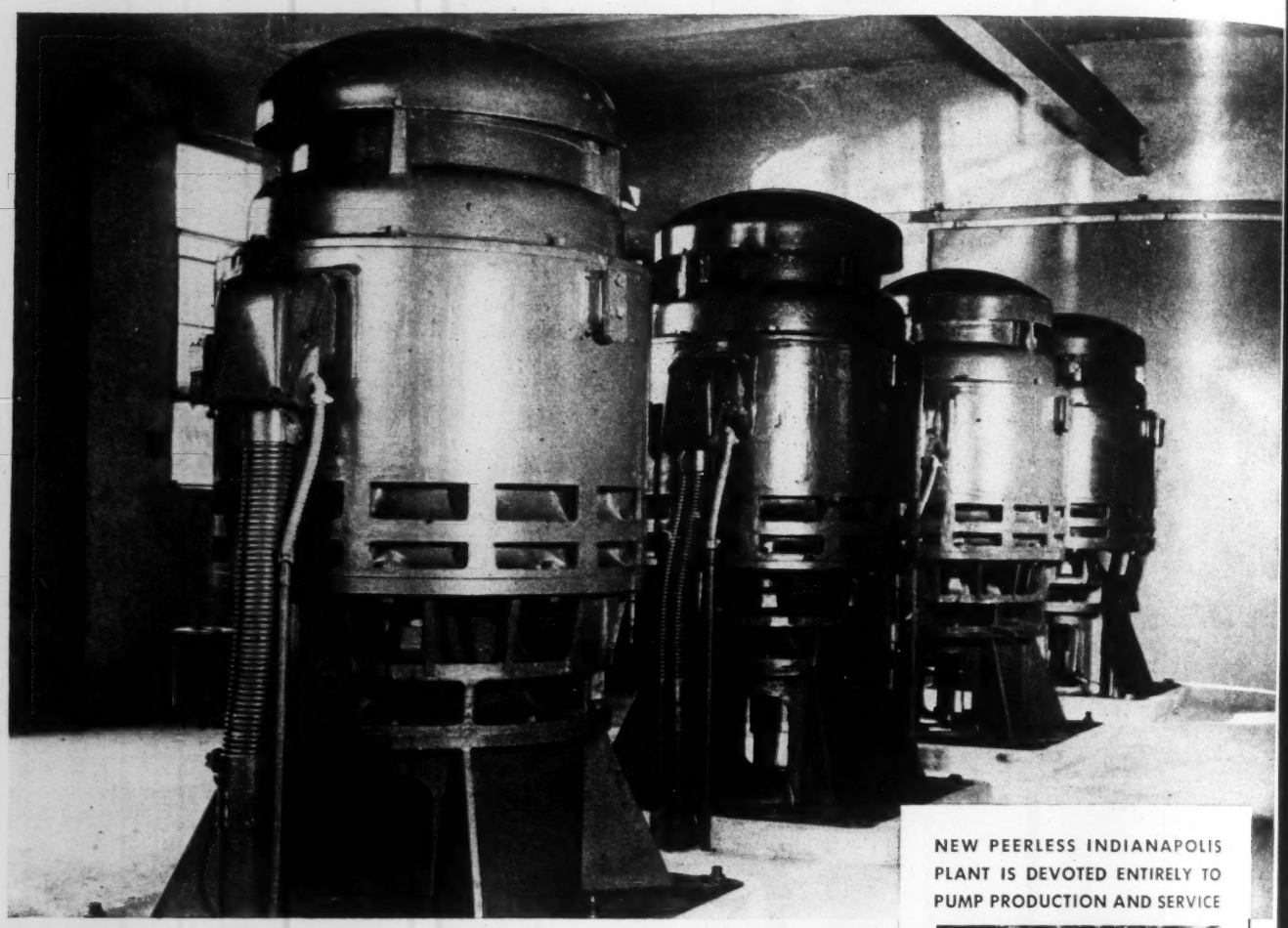
Across the mountains, over the valleys, under the plains, you'll find "The pipe with the yearmark" at work silently, dependably, economically transforming the waste places of the nation . . making the desert blossom like the rose.

WHEATLAND TUBE COMPANY

Bankers Securities Building · Juniper & Walnut Streets · Philadelphia 7, Penna.

-pipe with the yearmark!

PEERLESS VERTICAL TURBINE PUMPS



CUT OVERHEAD Underground

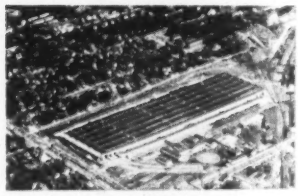
For your next job consider the flexibility and the efficiency of the Peerless vertical turbine pump.

As a deep well pump, for example, a Peerless pump can assure you of an independent source of clean water from your own well—water that will be of constant temperature, of constant chemical analysis. To cut overhead underground, Peerless turbine pumps embody many exclusive engineering advantages, such as patented Double Bearing-Double Seal bowl construction, all contributing to their extended trouble-free pumping life.

As another example, a Peerless vertical turbine pump utilized as a close-coupled pump, assures you of full turbine pump utility and capacity from short or medium settings. They're ideally suited for installation over pits, sumps or basins or for pumping water from surface sources. The 4 pumps shown above are indicative of this type of service. You can easily visualize their application to condenser cooling, cooling tower service, etc.

Regardless of your requirements, a versatile Peerless vertical turbine pump will squarely meet your pumping demands. Peerless offers widest capacity range, from 15 to 30,000 gpm against heads to 1000 feet. You can have your choice of oil lubricated or water lubricated types and a choice of power drive, direct-connected electric, right angle gear, V or flat belt or combination drives. Write for individual Bulletins describing the applications of Peerless pumps to these services.

NEW PEERLESS INDIANAPOLIS PLANT IS DEVOTED ENTIRELY TO PUMP PRODUCTION AND SERVICE



Here is one of America's newest pump plants—19 acres of modern manufacturing facilities devoted to precision production of horizontal and vertical pumps, centrally located at Indianapolis. Plan with Peerless for pumps plus fast, complete pump service.

PEERLESS PUMP DIVISION
FOOD MACHINERY AND CHEMICAL CORPORATION

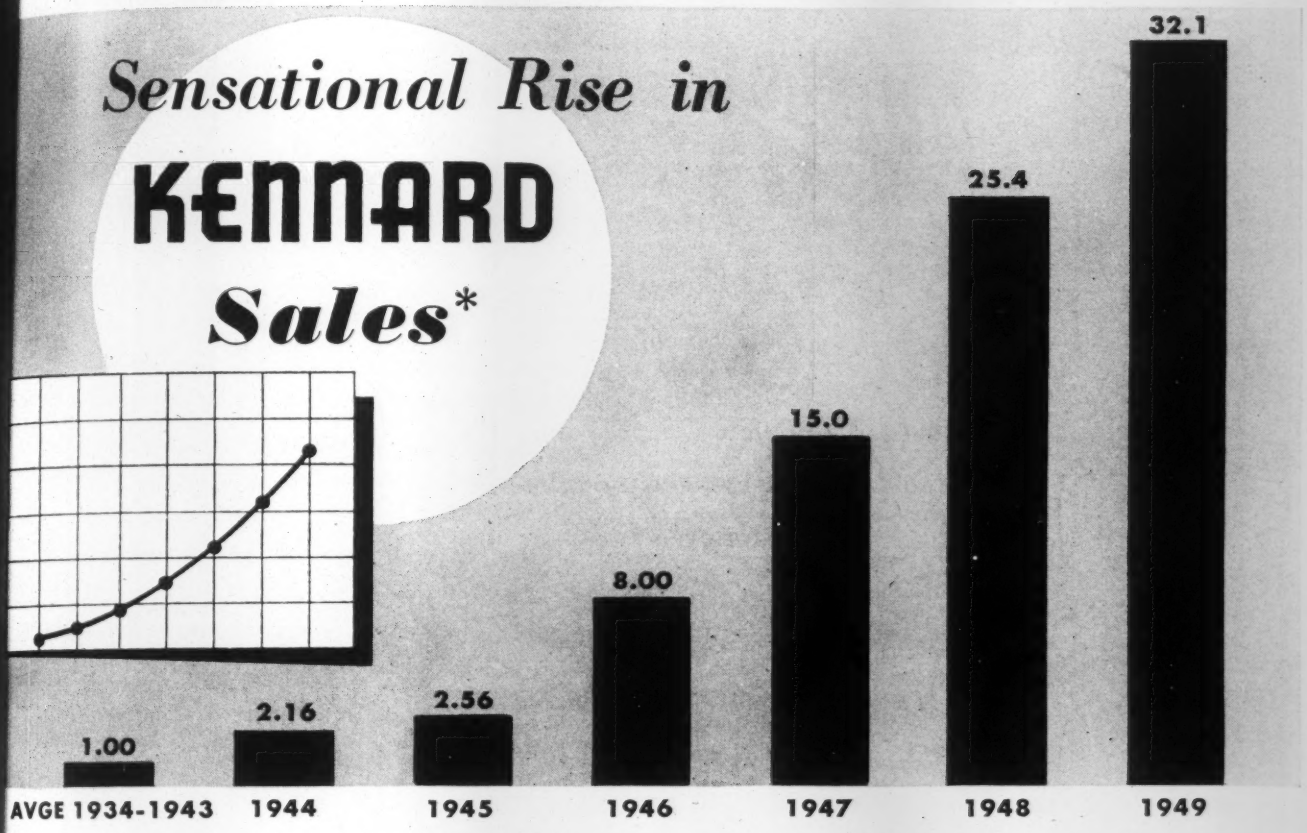
Los Angeles 31, California — Indianapolis, Indiana

District Offices: New York 5, 37 Wall Street; Chicago 40, 4554 N. Broadway; *Atlanta Office:* Rutland Building, Decatur, Georgia; Omaha, Nebraska, 4330 Leavenworth Street; Dallas 1, Texas; Fresno, California; Los Angeles 31, Calif.

Peerless
VERTICAL AND HORIZONTAL
Pumps

There MUST be a Reason!

Sensational Rise in KENNARD *Sales**



**Taken from sales volume records representing unitary dollar volume.*

The old adage "nothing succeeds like success" is proved again. We are giving these facts of Kennard's phenomenal growth not in a boastful vein . . . but because *they mean so much to YOU.*

In the face of a growing "buyers' market" with competition becoming razor keen Kennard shoots ahead in sales! Why? Because KENNARD HIGHER QUALITY plus Dollar Savings is a combination that industry acceptance proves in these figures—represents unbeatable intrinsic VALUES.

If you are in the market for heat transfer products (Blast Coils, Air Conditioning Units, Evaporative Condensers or Cooling Towers), we invite you to consult with us now—PROMPT DELIVERIES.

Write for Catalogs and Bulletins

No. 47A—FINNED COILS
No. 486—AIR COND. BLOWER UNITS
No. 491—EVAPORATIVE CONDENSERS
No. 494—COOLING TOWERS

Refinement of detail marks the difference between ordinary and excellent.

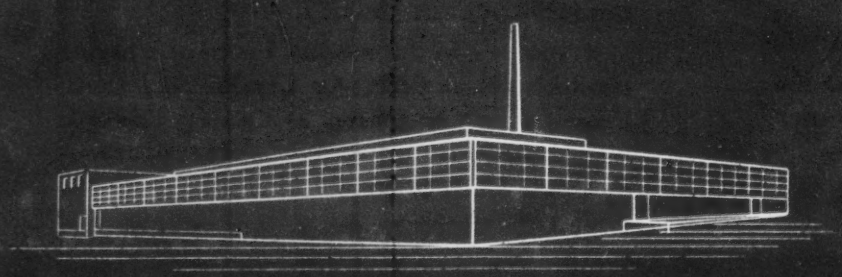
KENNARD CORPORATION • **1817 S. HANLEY ROAD ST. LOUIS 17, MISSOURI**

SALL MOUNTAIN COMPANY
Asbestos
UTILITY
SERVICE
ECONOMY

SINCE the year 1886, when Sall Mountain Company was founded, this company has taken a leading position in manufacturing Asbestos Products and in the fitting of asbestos to an ever widening field of industrial uses.

The latest in advance equipment is of course, important, but most important is the long years of Sal-Mo experience in solving problems involving the use of Asbestos.

SALL MOUNTAIN COMPANY
ANdover 3-2414 • 176 W. Adams St. • Chicago 3

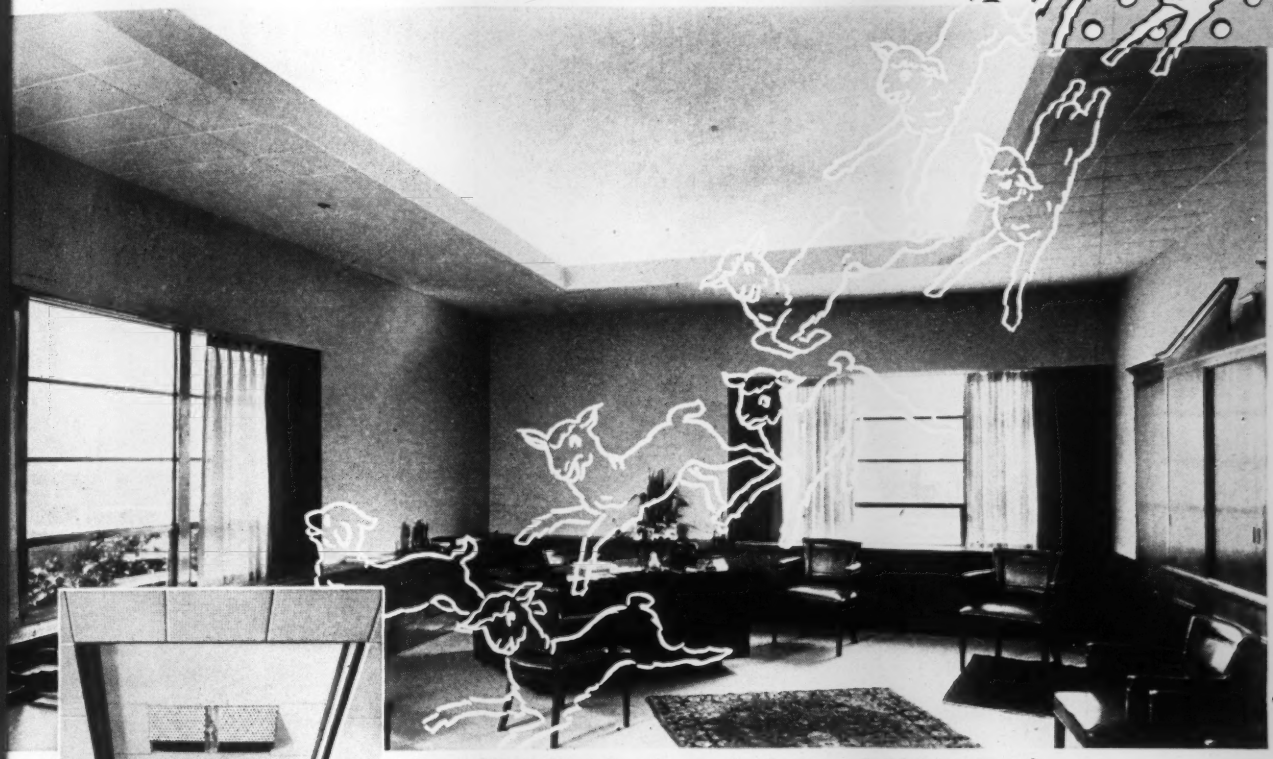


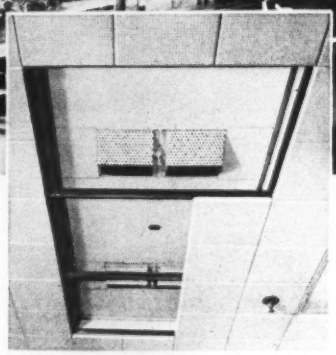
At our mills we have the latest improved and highly specialized equipment and machinery for processing Asbestos and Asbestos Products.

It is always as gentle as spring

in any air conditioned room with

MULTI-VENT* *LOW VELOCITY* DIFFUSION





Above: **Multi-Vent Panels completely concealed behind metal acoustical ceiling surrounding the light cove in an office of the new Hibbard, Spencer, Bartlett & Co. Building, Evanston, Ill. Architects and Engineers, Engineering Systems, Chicago.**

Left: **Concealed Multi-Vent Panel exposed by removal of metal acoustical ceiling pans.**

*T.M. Reg. U. S. Pat. Off.

Truly superb air conditioning comfort is assured by the use of Multi-Vent perforated ceiling diffusion panels. Unlike all other diffusers on the market today, MULTI-VENT does not rely on "throw" or "blow" to distribute conditioned air. Duct velocities are so radically reduced within the panel itself . . . diffusion so thorough and rapid that no air movement in excess of ASHVE comfort zone requirements exists more than six inches below the ceiling! Therefore, all problems of outlet location, adjustments for throw and drop to avoid drafts are eliminated. Air Volume delivered through individual panels may be varied and supply reduced as much as 60% in zoned systems without disturbing the balance or affecting the desired spread and radius of diffusion. Moreover, Multi-Vent diffusion can handle greater amounts of air in proportion to room size than any other diffuser and still maintain the most exacting comfort zone requirements. Simple to install in virtually any type of building—new or old . . . quick to balance . . . easy and economical to clean. Complete information and selection data gladly sent in response to your inquiry.

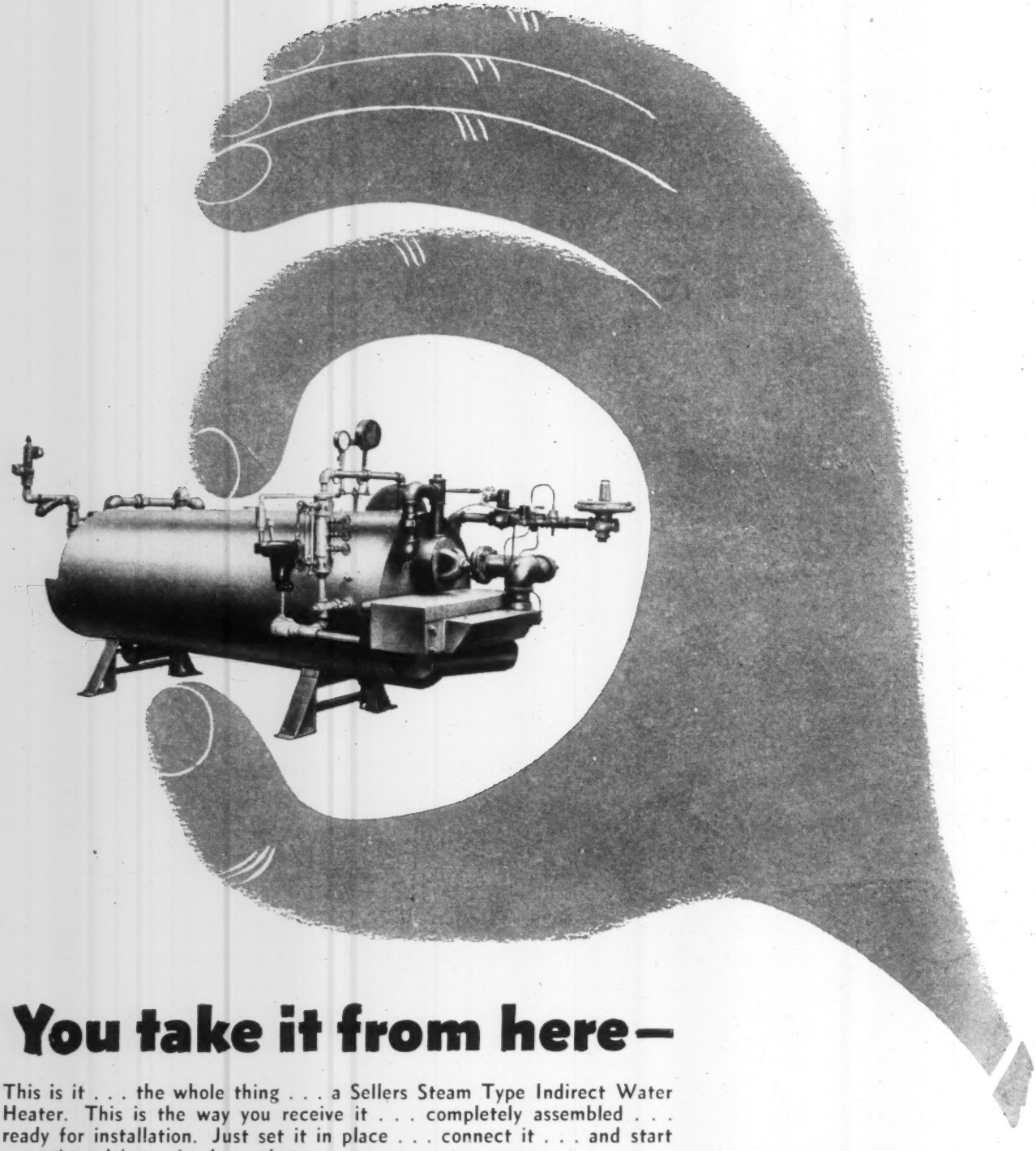
MULTI-VENT DIVISION

THE PYLE-NATIONAL COMPANY

1373 WEST 37TH STREET, CHICAGO 9, ILLINOIS

Sales Engineers and Agents in the principal cities of the United States and Canada.

SINCE 1897



You take it from here—

This is it . . . the whole thing . . . a Sellers Steam Type Indirect Water Heater. This is the way you receive it . . . completely assembled . . . ready for installation. Just set it in place . . . connect it . . . and start operation. It's as simple as that.

This is Sellers' answer to the toughest problem in water heating. It heats water in large volume. It handles pure zeolite softened water, corrosive soft waters, and waters of high oxygen and carbon dioxide content without damage to the equipment and without costly pre-treatment. And it does the whole job with amazing efficiency and economy.

Furthermore . . . this unit will deliver hot water at two different temperatures if desired. Steam up to 15# pressure is available for space heating. The heat exchanger is easily removed for cleaning. And the boiler is built in strict accordance with A.S.M.E. Codes.

For supplying hot water in large volume in hotels, restaurants, laundries, and apartments, this equipment offers exceptional advantages . . . and worthwhile profits to the alert dealer. Get the full story. Write for our Bulletin No. 1202. There's no obligation.

Sellers
STEAM TYPE
INDIRECT
WATER HEATER

SELLERS ENGINEERING COMPANY
4876 No. Clark St., Chicago 40, Illinois

Immersion Automatic Water Heaters - Blast Heaters - Immersion Steam Boilers - Air Heaters - Vertical Steam Boilers - Combustion Units - Industrial Gas Burners - Immersion Tank Heaters - Gas Combustion Equipment

THERE'S NO PLACE FOR THESE TROUBLEMAKERS • •

IN PLANTS THAT CAN MAKE A STATEMENT LIKE THIS • •

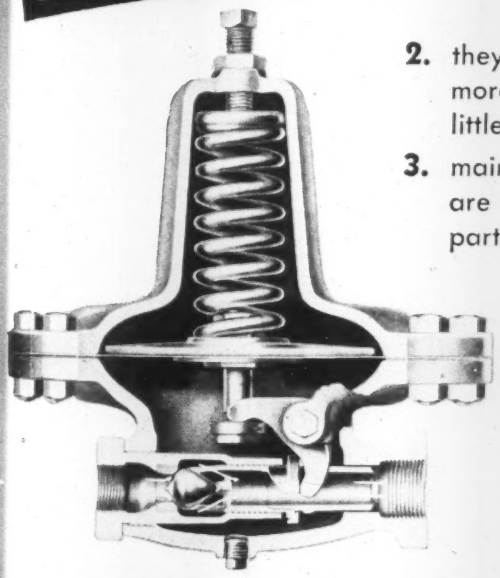
"We use your Streamlined '1000' Valves on the following equipment:

Heating Systems
Solution Heaters
Plating Tanks
Degreasing Machines
Hot Water Heaters

CASH STANDARD Streamlined TYPE 1000 PRESSURE REDUCING VALVE

"We use them:

1. because they hold close delivery pressure control.
2. they don't get gummed up, so we get more and better production with very little lost time.
3. maintenance cost is very low—the guts are cheap—old parts come out and new parts go in easily with little time lost."



ITS ASPIRATOR AND STREAMLINED FLOW WORK TO YOUR BENEFIT IN THESE 12 WAYS . . .

1. Maximum Capacity when needed most. 2. Accurate Pressure Control under toughest working conditions. 3. Trouble-free Service. 4. Smooth Operation. 5. Tight Closure. 6. Accurate Regulation. 7. Speedier Production Results. 8. Elimination of Failures. 9. Constant Delivery Pressure. 10. Cost Saving Operation. 11. No Spoilage. 12. Practically zero in maintenance costs.

CASH STANDARD CONTROLS . . . VALVES

A. W. CASH COMPANY
DECATUR, ILLINOIS

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BULLETINS AVAILABLE ON OTHER CASH STANDARD VALVES

Send for them

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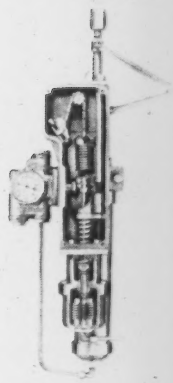
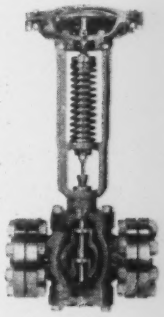
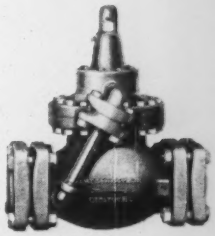


Bulletin 963 features the CASH STANDARD Type 100 Series of Super-Sensitive Controllers — various types for automatically operating valves, dampers, rheostats, stokers, pulverizers, fans, and other apparatus. 16 pages filled with descriptions and applications.



Bulletin 968 features the CASH STANDARD Type 34 Pressure Reducing Valve — direct operated — direct acting for handling steam, hot water, cold water, air, oil, brine—and most liquids and gases except some injurious chemicals. Illustrates and describes the different styles available and tells about their applications. Three pages of capacity charts.

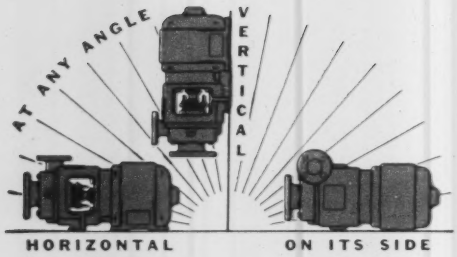


Bulletin 956 features the CASH STANDARD Type 4030 Back Pressure Valve — designed to automatically maintain a constant pressure in the evaporator corresponding to a constant temperature desired. Shows an Ammonia and Freon Gas Capacity Chart based on ABSOLUTE pressures.

THE BACKBONE

of PRODUCTION

the Ingersoll-Rand MOTORPUMP



No matter what the processes in your phase of manufacture, there undoubtedly are pumps involved . . . pumps that are the backbone of your production. When you think of pumps in this light, dependable pumps mean continuous production.

When you talk about dependable close-coupled pumps you're talking about the INGERSOLL-RAND MOTORPUMP line. There are hundreds of sizes and models available to meet a multitude of conditions. These are compact, self-contained units built for heavy-duty service.

Each MOTORPUMP is just what the name implies . . . an electric motor and pump combined. Special motors are equipped with extra-heavy shafts and bearings. The pump with balanced impeller is assembled directly on the motor shaft. This compact construction gives perfect balance, vibrationless operation and extreme rigidity. The MOTORPUMP involves no large installation cost because it requires no special foundation, will operate efficiently in any position, horizontally, vertically, at any angle or on its side. Sizes ¼ to 40 horsepower . . . gallons to 1800 per minute . . . heads to 600 feet.

You can depend on Ingersoll-Rand MOTORPUMPS to ease your pumping headaches. Factory trained pump specialists from coast to coast are always ready to help you and can give you prompt shipment.

COMPRESSORS
TURBO BLOWERS
OIL & GAS ENGINES
PUMPS
CONDENSERS
AIR TOOLS
ROCK DRILLS

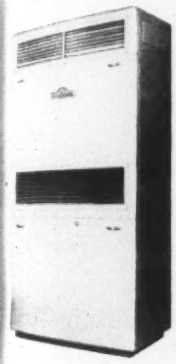
Ingersoll-Rand

Cameron Pump Division
11 Broadway, New York 4, N. Y.

EQUIPMENT DEVELOPMENTS

For your convenience in obtaining more information about any of this equipment, see coupon on this page. Add the new products and companies listed here to your Directory Section which you received in your January 1949 Heating, Piping & Air Conditioning and thus keep your records of sources of supply up to date throughout the year. Single asterisk indicates equipment not listed in Directory Section; double asterisk equipment and manufacturer not listed.

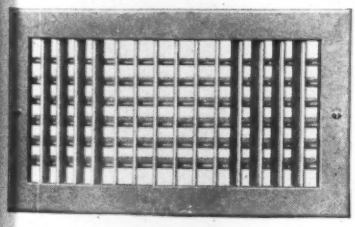
Packaged Conditioner Available With Open or Hermetic Unit



No. 4079 — The restyled "Baker-aire" packaged air conditioning units are available in 3, 5, 7½, and 10 ton sizes, with either open or hermetic condensing units, from Baker Refrigeration Corp., South Windham, Me.

Completely self contained, units incorporate centrifugal fans having capacities of 1200, 2000, 3000, or 4000 cfm, depending on the conditioner size. Cooling coils are ⅝ in. OD copper tubing and standard coils are five rows deep with seven fins per inch. Finned coils for hot water or steam heating can be located above the cooling coils. The discharge grilles in the top of the unit have movable louvers and direction vanes. Ducts may be attached at grille openings or the top deck may be removed for duct installation. For the 10 ton hermetic unit, two 5 hp compressors are used. This, says the company, permits a 50 percent capacity reduction.

Improved Streamlined Bars Feature Registers, Grilles



No. 4080 — Auer Register Co., 3608 Payne Ave., Cleveland 14, has improved its "Streamliner" series of registers and grilles for air conditioning and ventilation by the use of hollow molded bars which are beveled on the edges.

The series includes models with a single bank of adjustable bars, either vertical or horizontal, and also with double banks of bars. These units may be fitted with multi-louvered valves in the back. Other features are said to include pivoting of bars on special expansion inserts, designed to create the proper tension for keeping bars tight when set, and the mounting of shutters on multi-louver valves by an improved method.

Redesigns Convectors for Quick, Easy Installation

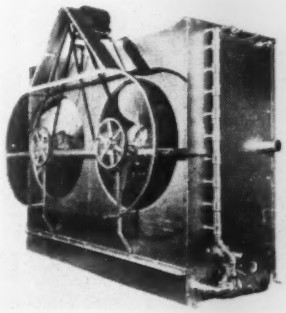
No. 4081—Airtherm Mfg. Co., 700 S. Spring Ave., St. Louis 10, has redesigned its line of convector radiators for quicker, easier installation and assembly.

Units are now available in 4, 6, 8 and 10 in. depths and a full range of lengths and heights. There are models for free standing or recessing, sloping top and regular front wall hung types, and flush recessing.

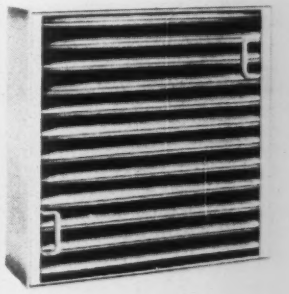
Extends Line of Evaporative Condensers

No. 4082—The line of CPE outdoor type evaporative condensers offered by Baltimore Aircoil Co., Inc., 715-17 W. Pratt St., Baltimore 1, has recently been extended. Offered in 19 different sizes, single units are now available in capacities from 10 to 100 tons.

Units are said to feature true counterflow heat transfer with both air and water, to be extremely compact, and to have low horsepower requirements. The fan is located on the "dry" side.



Evaporative Condenser



Air Recovery Unit

Activated Carbon Air Recovery Unit Has Cell Type Construction

No. 4083—W. B. Connor Engineering Corp., 114 E. 32nd St., New York 16, is now in volume production on a new "Dorex" self contained, cell type activated carbon air recovery unit for air conditioning and ventilating systems.

With a capacity of 1000 cfm, this type C unit is said to have overall dimensions of 24 x 24 x 8¾ in. deep, low air flow resistance, and to provide a simple, effective air purification device that can be installed and serviced with the ease and facility of a dust filter. The "accordion pleat" construction of the perforated filter element provides a filter face area of 28 sq ft in a space of less than 3 cu ft.

Applied in air conditioning to recover or convert stale odorous air by adsorption of impurities, the cell requires no preliminary engineering design and minimum duct accommodations. It may be installed in multiple, in either flat or v arrangement.

FOR YOUR CONVENIENCE

Heating, Piping & Air Conditioning [7-49]
6 N. Michigan Ave., Chicago 2, Ill.

Please ask the manufacturers to send me more information about the equipment mentioned under the following reference numbers in Equipment Developments and Recent Trade Literature

(Circle each number in which you are interested)

4079	4080	4081	4082	4083	4084	4085	4086	4087	4088
4089	4090	4091	4092	4093	4094	4095	4096	4097	4098
4099	4100	4101	4102	4103	4104	4105	4106		
7309	7310	7311	7312	7313	7314	7315	7316	7317	7318
7319	7320	7321	7322	7323	7324	7325	7326	7327	7328
7329	7330	7331	7332	7333	7334	7335	7336	7337	7338
7339									

Name..... Title.....

Company .....

Address .....

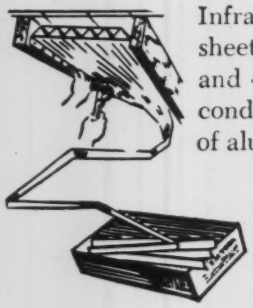
City..... Zone..... State.....

It works both ways!
Infra Insulation Blocks Wasteful Heat Flow

In summer, Infra compartmented aluminum insulation EXCLUDES 97% of Radiant Heat from the building; in winter, Infra CONFINES 97% of Radiant Heat.

Loss of heat, or its intrusion, through Conduction or Convection, are also effectively blocked. An impermeable barrier to moisture and water vapor, as well as to warm and cold air, is set up. The harboring of mold, fungi, dry rot and vermin is prevented.

Every time you install Infra in a building, you make a generous contribution to the comfort and economy of those who live or work there.



Infra's multiple separated aluminum sheets provide 4 reflective spaces and 4 reflective surfaces, each non-condensation-forming. Two sheets of aluminum and the accordion partition block convection currents. Infra's triangular reflective air spaces and small mass eliminate conduction as a problem.

Infra C Factors and Rockwool Equivalents
C.052 Heat Flow Down, equals 6" Rockwool.
C.083 Heat Flow Up, equals 4" Rockwool.
C.10 Lateral Heat, equals 3½" Rockwool.

Thermal Factors Printed on Every Infra Carton

Write **FOR FREE 32-Page BOOKLET:**
"Simplified Physics of Thermal Insulation"

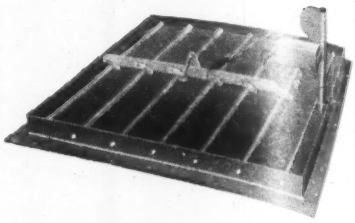
Architects and engineers use it as a handbook, and colleges as a text, on heat transfer, condensation, vapor, mold, radiant heating, etc. Contains chart of k, C, R and U factors of all insulations, of all thicknesses, weights, densities.

Address Dept. **AC**

MULTIPLE ACCORDION ALUMINUM and TRIANGULAR REFLECTIVE AIR CELLS

Infra INSULATION, INC.
10 Murray St., N. Y., N. Y.

Ceiling Shutter Equipped With Mercury Switch

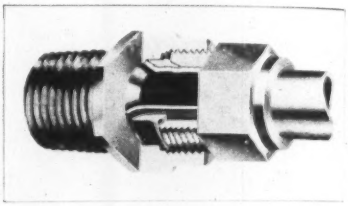


No. 4084 — A new ceiling shutter with a mercury switch for synchronizing starting and stopping of a fan with the opening and closing of the shutter is available from Elgo Shutter & Mfg. Co., 2738 W. Warren Ave., Detroit 8.

When the shutter is opened by the pull chain, the switch starts the fan motor, and when the pull chain closes the shutter, the same mechanism stops the fan. Another safety feature is a fusible link which, in case of fire, is designed to close the shutter and also stop the fan.

The unit is adapted to both vertical and horizontal discharge of air, and a number of the units may be installed in various parts of a room or building and can be operated by a single fan.

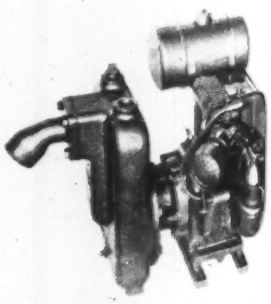
Refrigeration Tube Fitting Is Self Flaring



No. 4085 — A self flaring, "Uniflare" tube fitting that can be taken apart and reconnected many times, it is claimed, without weakening the seal or damaging the flare is offered by Scovill Mfg. Co., Waterbury 91, Conn.

Said to be leakproof and to have only two parts (body and nut), it incorporates a thrust collar in the nut. The collar is designed to shear off, under ordinary wrench force, and to clamp onto the tube to form a sealed joint. No special skill or tools are required for assembly. This refrigeration fitting is supplied in both forged and standard types and is available in a complete range of sizes and shapes for use with copper, aluminum, monel and annealed steel tubing.

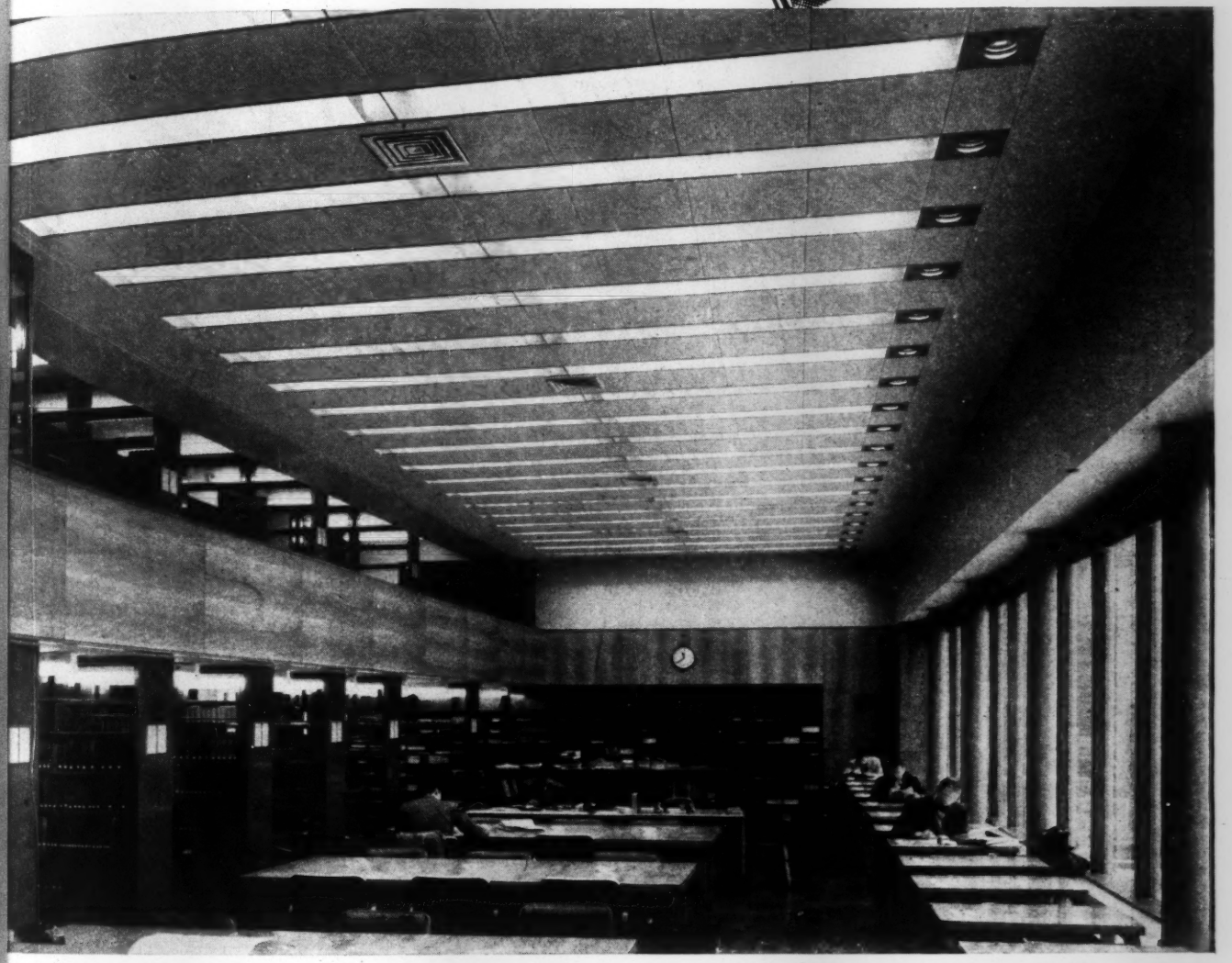
Packaged Pumping Unit Provides Flood Protection



No. 4086 — A new self priming pumping unit, for use where electric power or belting facilities are not available, has been designed by Gardner-Denver Co., Quincy, Ill. Known as the type LDA, this packaged unit consists of a self priming centrifugal pump close coupled to an air cooled gasoline engine.

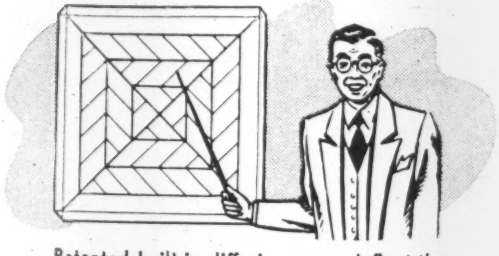
A double discharge volute is said to assure efficient priming, and a mechanical seal is used to eliminate a stuffing box and packing gland. The unit is equipped with an open type impeller for dewatering service where some small solids may be encountered. Capacities are from 75 to 250 gpm at a 110 ft head. The pump is recommended for flood protection during power failure.

AGITAIR goes to . . . HARVARD



Lamont Library at Harvard University with acoustical ceiling, modern lighting and versatile Agitair Type R's that blend perfectly with surroundings.
Architects: Coolidge, Shepley, Bulfinch & Abbott.
Heat. & Air Cond. Eng.: Buerkel & Co., Inc.

Here's the Secret of Greater Diffusing Ability:



Patented built-in diffusing vanes deflect the air in numerous divergent streams resulting in turbulence at the point of contact with the aspirated air. Result: Rapid mixing, diffusion and temperature equalization.

Quiet and comfort are musts in a college library. That's why you'll find Agitair Type R's providing noiseless, draftless air diffusion at Lamont Library, Harvard. These diffusers assure 100% air distribution in any shape area from any location . . . blend perfectly with modern architectural treatments.

Write for Complete Data

AIR DEVICES, INC.
17 East 42nd St. • New York 17, N. Y.
AIR DIFFUSERS • AIR FILTERS • ROOF EXHAUSTERS

You can get
DIRECTED AIR FLOW
at any angle with

INDEPENDENT
"Fabrikated"
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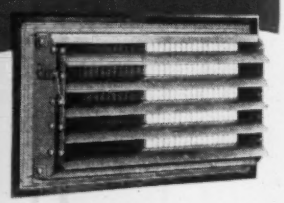
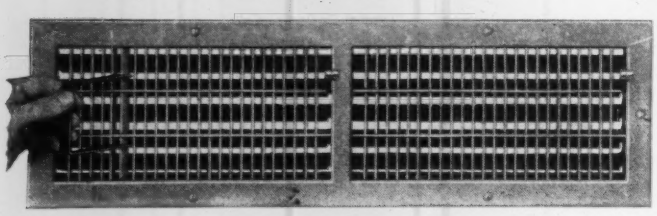
AIR CONDITIONING
REGISTERS

321-A HMV



Rear View Showing "HMV" Valves

Every grille bar adjustable individually—before or after installation



321-A HMV Tandem

Any direction of air flow—right, left, up, down and any combination—is easily obtained with "Fabrikated" Style No. 321-A HMV air conditioning registers, for residence or commercial installations, on sidewalls or ceiling. The face bars are adjustable to right or left; valves on the back are adjustable to direct the air flow up or down; valves may also be fully closed, and are connected to open or close in unison.

The angles of deflection and the combinations to be had are practically unlimited. Adjustments for directed air flow may be made before or after installation. Grille bars are held firmly in place and will not vibrate or rattle.

"Fabrikated" registers are available in sizes from 8 x 4″ to 48 x 24″, including tandem style. Special sizes can be made without special die set-up charges.

Write for Catalog No. 48.

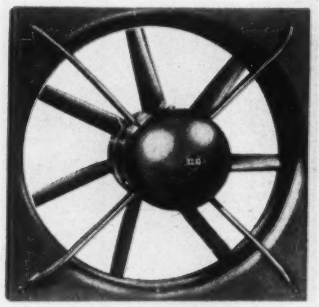
Always Leading—Always Progressing

THE INDEPENDENT REGISTER CO.
3747 E. 93rd STREET • CLEVELAND, OHIO

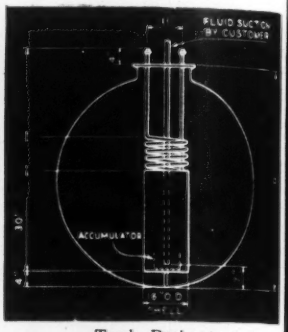
Develops Farm Fan for Curing, Drying

No. 4087—Development of a 42 in. direct connected fan designed specifically for farm drying and curing operations, has been announced by the Ilg Electric Ventilating Co., 2850 N. Crawford Ave., Chicago 41.

Named the "Ilgfarmaire," it has a cast aluminum, non-overloading fan wheel, is equipped with a 5 hp, 1140 rpm, 220 volt, single phase, 60 cycle capacitor motor, and has direct connection of the motor and fan wheel. According to the company, it will deliver 25,000 cfm at ½ in. static pressure and 20,000 cfm at ¾ in. static pressure, the most common pressures encountered in curing and drying operations. It is said to handle almost all cribs and mows since 5 cfm is recommended for drying each bushel of corn and 15 cfm for each 15 feet of mow area.



Farm Fan



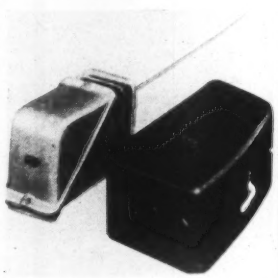
Tank Preheater

Preheats Oil and Other Heavy Bodied Substances

No. 4088—The "Hot-Spot" bulk tank preheater is fabricated to fit any bulk tank having a manhole 15 in. or larger and is designed to heat viscous oils and other heavy bodied substances. The manufacturer is Rempe Co., 340 N. Sacramento Blvd., Chicago 12.

The heat source is either steam or hot water. A 12 ga sheet steel shell and a coil assembly of 1½ in. standard steel pipe are said to provide 38 sq ft of direct radiation surface plus 10 sq ft of secondary shell heating surface. Inlet and outlet connections are furnished and various lengths of pipe are available for different tank diameters.

Protects Gas Equipment from Flame Failure

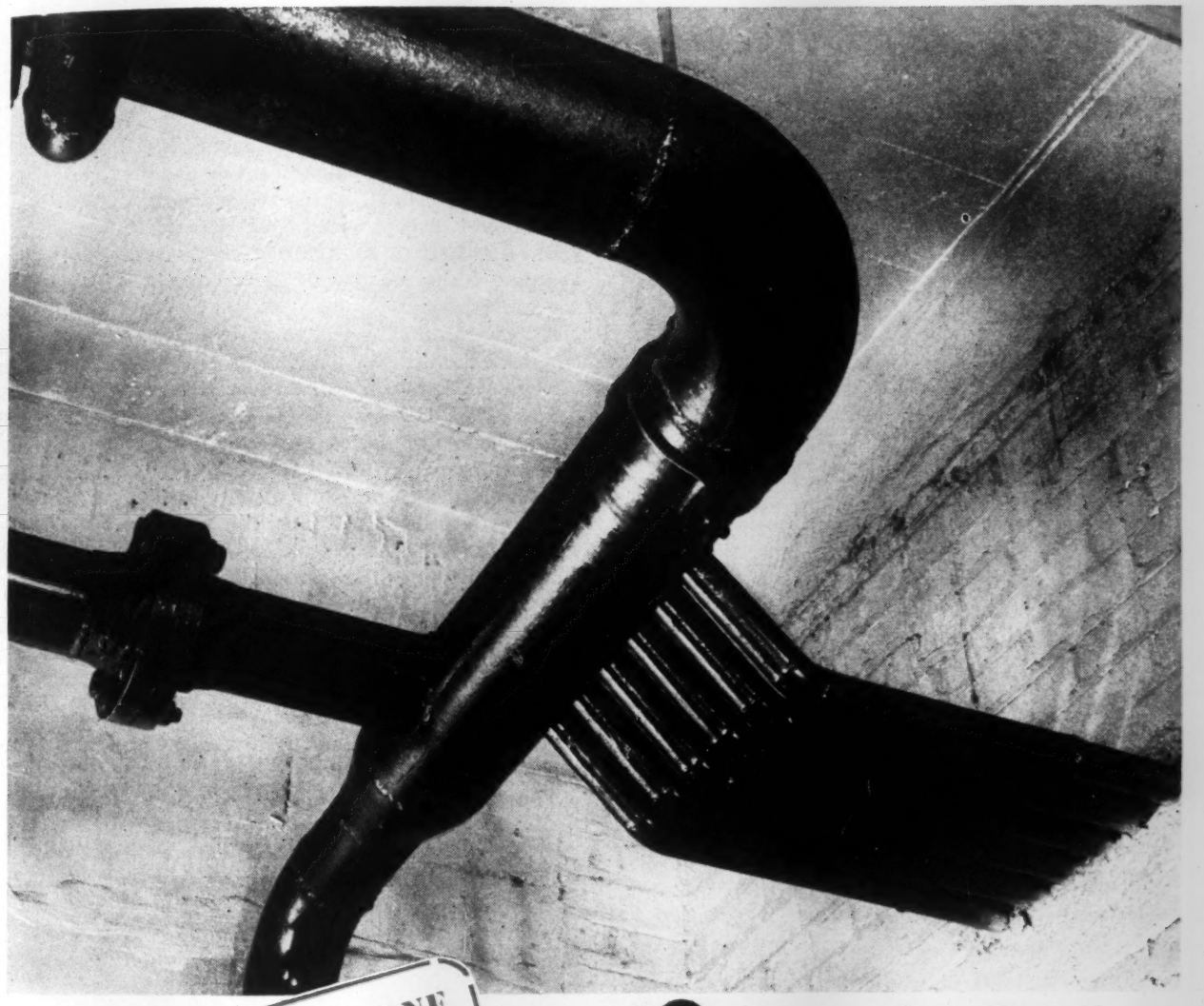


No. 4089 — Combustion Control Corp., 77 Broadway, Cambridge 42, Mass., has introduced the latest "Fireye" flame failure safeguard for industrial gas oven, kiln, and boiler protection. The equipment includes electronic flame rod type 45JQ1 and control 24QJ5.

When flame fails, the flame rod signals this condition to the control which cuts off fuel and sounds an alarm. The flame rod is mounted near the gas pilot on the burner plate and projects into the fire chamber. It is so located that the tip of the rod impinges on the pilot or main gas flame. The rod is wired to the control which may be located at any conventient point.

According to the company, features include a fail-safe circuit with safety-start protection, simplicity of installation on all gas burner heads, and immunity to moisture and electrical leakage.

How to Tame a Tough Joint



ANOTHER JOB DONE BETTER WITH GLOBE WELDING FITTINGS

KEEP an eye on the future when you install piping — even the most innocent looking connection can become a "tough joint" through leakage — pressure-loss — the focal point for erosion and corrosion — constant maintenance time and cost.

You can tame probable "tough joints" in piping by making connections with permanently tight, leakproof Globe Welding Fittings. Strength is forged in the fittings — flow friction and pressure-loss minimized by precision formed true angles, radii, circularity—weight and space requirements reduced — exact dimensional accuracy that saves time, speeds piping assembly. To do any piping job better — use Globe Welding Fittings produced from Globe seamless steel tubes by the Globe Precision Process.

GLOBE STEEL TUBES CO., Milwaukee 4, Wis.

Producers of Globe seamless stainless steel tubes — Gloweld Welded stainless steel tubes — carbon — alloy — seamless steel tubes — Globeiron seamless high purity ingot iron tubes — Globe welding fittings.

For complete information on sizes and types send for Globe Welding Fittings Catalog.

GLOBE PRECISION PROCESS WELDING FITTINGS

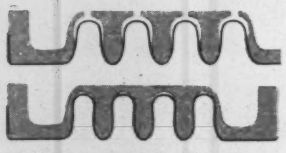
ANOTHER REASON WHY

Badger

IS FIRST IN

expansion joints

EXCLUSIVE
all-curve corrugations
equalize stresses



Because the flexing member is made from a single tube, Badger Expansion Joints are installed without packings. This feature alone means valuable savings in man hours . . . assures long service without attention.

And that's only *one* reason why you get top performance — *at lowest cost* — from Badger Corrugated Expansion Joints. Here are others:

- Flexible . . . joints easily compress and expand reducing thrust on adjacent fittings and equipment
- Compact . . . require no more space than regular flanged fittings
- Special forming methods . . . no danger of structure-weakening stresses
- Controlled heat treating . . . to assure long life for flexing member
- Directed flexing rings . . . to equalize stresses *between* and *within* corrugations

These features are important in any pipe line job — you can get them *all* only by specifying Badger Expansion Joints.

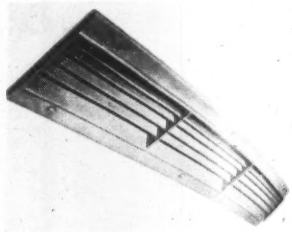
Write today for Bulletin 100 (self-equalizing type) or Bulletin 200 (non-equalizing type).

Badger

MANUFACTURING COMPANY

260 BENT ST. CAMBRIDGE 41, MASS.

Aspirating Air Diffuser Now Available in Straight Line Type



No. 4090—A straight line, aspirating air diffuser, designed primarily for railroad cars, buses, and also for other installations requiring long rectangular units, is offered by Anemostat Corp. of America, 10 E. 39th St., New York.

Standard length of the unit is 60 in., although this dimension will be varied by the manufacturer to suit the user's needs. Air quantities handled are 15 to 20 cfm for each foot of diffuser length, and a double row provides up to 40 cfm. Tip velocities are about 700 fpm through the valving arrangement, when handling design air quantities. Maximum static resistance is 0.2 in. of water.

Air distribution is said to be equalized throughout the length of the diffuser installation by means of adjustable volume shutters which are accessible on the face side.

The unit is fabricated so as to facilitate its use in individual panels of varied lengths, or it can be assembled into continuous extended strips. Many combinations are obtainable, with or without continuous or individual lighting fixtures. Units may be mounted back to back to form one diffuser, or may be separated so as to accommodate all types of lighting arrangements.

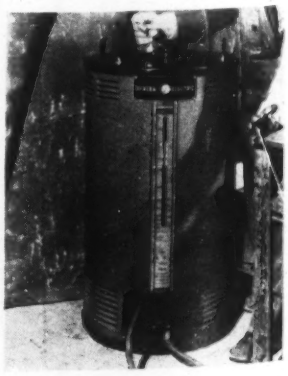
Increases Strength, Service Life of 125 lb Bronze Valves

No. 4091—According to Lunkenheimer Co., Cincinnati 14, greater strength and longer service life are features of the improved line of 125 lb (steam pressure) bronze globe, angle, and check valves.

The globe and angle valves have a malleable iron handwheel, a hexagon head gland designed to eliminate "prying" when repacking, machined repacking seats, and solid bronze discs which are renewable on the $\frac{3}{4}$ in. and larger sizes. Valve stems are of silicon bronze alloy. Check valves are said to have similar features of design and strength. In the lift check unit, guide lugs are used on the disc and guide sleeve in the cap to assure positive seating. In the swing check valve, two renewable side plugs serve as bearings for the disc carrier pin.

These valves are also offered for 200 lb water, oil or gas service.

Increased Range Features Line of A-C Arc Welders



No. 4092—A new line of a-c arc welders, featuring increased welding range and stepless precision current control, has been announced by General Electric Co.'s welding divisions, Schenectady 5, N. Y.

The new welders are available in 200, 300, 400, and 500 amp models for indoor manual welding; 750 and 1000 amp models for machine and submerged melt welding; and a special 200

Advertising Copy Policy . . .

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> "To refuse to run any advertising copy in which any statement or representation is made which disparages or attacks the goods, prices, services or advertising of any competitor or of any other industry, or which contains statements or claims about an advertiser's own products or services which the publisher knows or has reason to believe are untrue or inaccurate."

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of Advertising Principles

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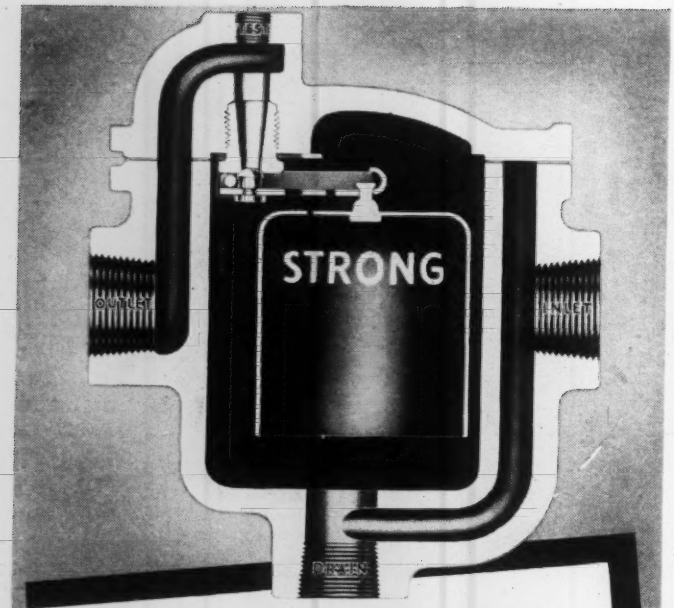
4. GOOD ADVERTISING---recognizes both its economic responsibility to help reduce distribution costs and its social responsibility in serving the public interest.

-Advertising Federation of America-

Heating, Piping & Air Conditioning



5 Reasons
STRONG* 70 Series Traps
give better service!

Look to these five reasons for long, trouble-free service in STRONG 70 Series Traps:

1. *Valve and seat guaranteed leakproof for one year*—made of STRONG's patented, wear-resistant Anum-Metl;
2. *Easy servicing*—permitted by the renewable seat design, cover with all working parts easily removed without breaking pipe connections;
3. *One piece bucket*—stainless steel, no welds;
4. *Turbulence avoided, choking minimized, 25% greater capacity*—with STRONG's exclusive Hi-Cap orifice;
5. *No dribbling, quick, full opening*—high ratio leverage.

STRONG *in-line* 70 Series Traps are available in sizes from ½" to 1", semi-steel construction. STRONG's "two-in-one" blast trap with integral thermal air vent is also available in the 70 Series (see cut below).

Catalog No. 68 describes these traps in detail along with other STRONG traps. Write today.

*Trademark Reg. U. S. Pat. Off.

STRONG, CARLISLE & HAMMOND COMPANY
1392 West 3rd Street
Cleveland 13, Ohio

ANUM METL Reg. Trade Mark

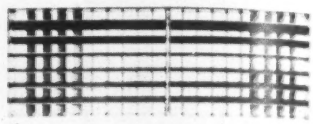
OTHER STRONG STEAM SPECIALTIES

Reducing Valve | Blast Trap | Strainer

STRONG

amp model for light duty, job shop welding. The 300, 400, and 500 amp models are offered also in weather resistant enclosures with "Idlematic" control for both indoor and outdoor operation.

Air Conditioning Grille Has Two-Way Directional Louvers



No. 4093—Titus Mfg. Corp., Waterloo, Iowa, is offering a new low cost air conditioning grille called "Airfoil" model No. 270.

It features two banks of streamlined louvers which are individually adjustable and which are made from extruded material. The frame is of one piece construction and is fitted with a rubber gasket. The company states that features include low cost and high efficiency, together with silent and more complete air diffusion. Sharp corners, holes, and crevices are said to be eliminated.

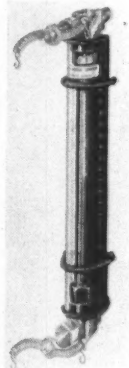
Working Parts Removable in Axial Flow Pump

No. 4094—A new "Pull-Out" model in axial flow and mixed flow pumps is designed so that the suction bell, impeller, impeller housing, shaft, motor, and motor base can be removed without disturbing the column and discharge elbow. Economy Pumps, Inc., Div. of Hamilton-Thomas Corp., Hamilton, Ohio, is offering sizes up to and including a capacity of 100,000 gpm.

Recommended for power plant condenser circulation and other continuous operations where it is desirable to disengage working parts for periodic inspection and cleaning, it is said to be particularly advantageous when the discharge elbow is below floor level or when the pump pit is not easily drained.

Units are supplied in either cast or welded construction and may be obtained in alloy materials.

Protects Against Bursting Gage Glasses



No. 4095—An improved gage glass protector, the No. 28 "Kleervu," for use on boilers and processing equipment has been developed by Wright-Austin Co., 315 W. Woodbridge St., Detroit 26, to safeguard both men and equipment against injury from flying splinters of glass and the escape of harmful fluids.

Designed to fit any gage upon which the dimension of the packing nut does not exceed 1⅞ in., the device completely encloses the gage glass. Top and bottom cadmium plated supports have been redesigned to provide a lip which fits into the "Nuglas" (¼ in. thick transparent plastic) front so as to prevent the escape of hot chemicals, propane gas, steam, etc.

The manufacturer states that the guard can be furnished in sizes ranging from 4 in. to 8 ft in height.

Pipe Line Strainers Remove Dirt from Water, Gas Lines

No. 4096—A new series of pipe line strainers has been placed on the market by Maid-O'-Mist, Inc., 3217 N. Pulaski Rd., Chicago. Made in three sizes with 3/8 in. IP tap inlet and outlet, they are designed for use on water, air, or gas lines.

Unusually large screen areas are said to assure efficient removal of dirt, rust, scale, and other foreign matter without effecting any noticeable drop in line pressure. Without disturbing any pipe connections, says the company, the 80 mesh monel woven wire screens can be quickly removed for cleaning.

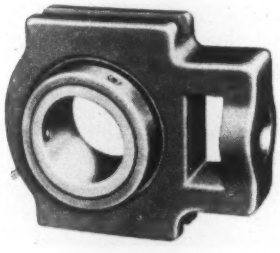
The screen in the No. 47 strainer (for air or gas only) comes packed with glass fiber to catch condensation from the air or gas. This condensation is blown off by turning the wheel-handle needle valve at the bottom of the strainer. Screens of other mesh can be furnished.

Relative Humidity Indicator Now Has a Fan Attachment

No. 4097—Accurate humidity readings can be obtained quickly in factories, shops, rooms, and even small, confined spaces near or in operating machinery, according to Weston Electrical Instrument Corp., 617 Frelinghuysen Ave., Newark 5, N. J. A new motor operated fan has been developed for attaching to any of the firm's relative humidity indicators.

The small fan, powered by dry cells, is said to move air over the indicator's wick in sufficient volume to permit obtaining stable readings within 30 sec. According to the company, this makes possible analysis of humidity conditions in, for example, a textile mill, particularly in and around the machinery while it is operating. No calculations are required, as readings are obtained on the instrument's simplified slide rule.

Ball Bearing Take-Up Unit Permits Shaft Position Changes



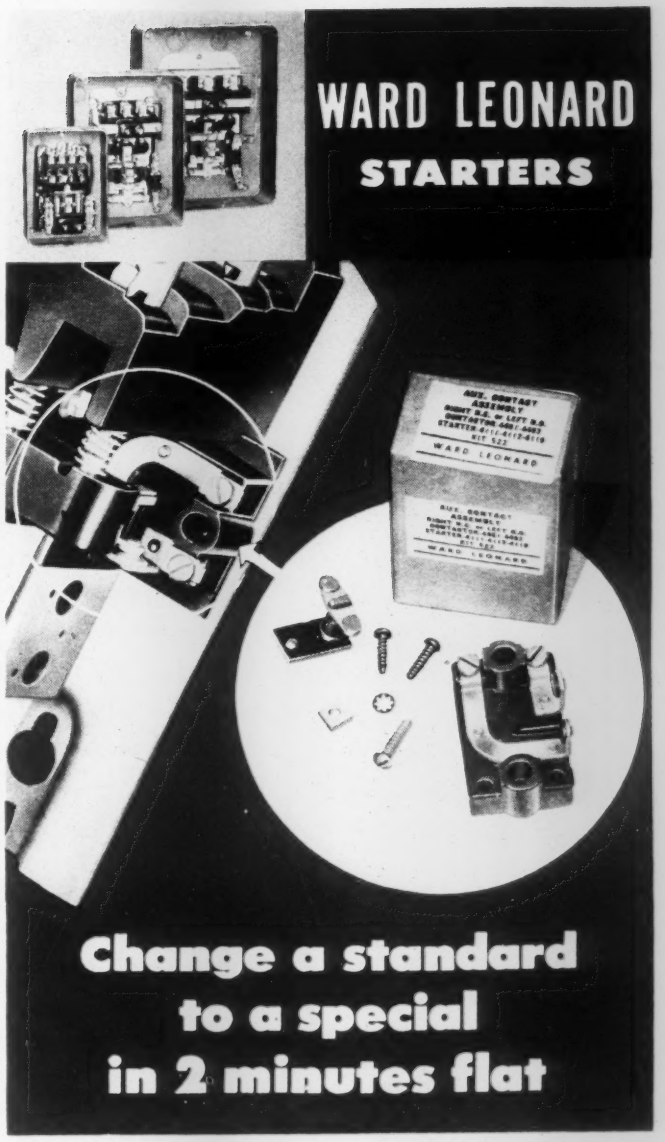
No. 4098 — Dodge Mfg. Corp., Mishawaka, Ind., has developed a new "Wide Slot SC" ball bearing take-up unit which consists of a deep groove precision bearing with large balls and retainer enclosed in an outer housing with wide milled slots or ways on each end for supporting guides.

The housing has a hole for receiving the unthreaded end of an adjusting screw This take-up bearing is said to be suitable for conveyor and power transmission service where provision must be made for changes in shaft position.

New Sump Pump Has All-Bronze Construction

No. 4099—All-bronze construction, a capacitor motor, an exposed coupling and a float switch feature the SB-540 sump pump offered by Weil Pump Co., 1528-38 N. Fremont St., Chicago 22.

The unit is said to be moderately priced and to be suitable for use where radio and television interference cannot be permitted.



Because basic design permits easy conversion

To reduce the number of control components carried in Original Equipment Manufacturer's stock, Ward Leonard offers auxiliary contact kits.

All parts including necessary hardware are packaged for quick identification, convenience in stocking and fast unit assembly. No special tools needed.

Auxiliary contacts can be assembled on all size 1, 2 and 3 solenoid starters. Available as normally open or normally closed contacts for right or left hand mounting.

Write Ward Leonard Electric Company, 24 South Street, Mount Vernon, N. Y. Offices in principal cities of U. S. and Canada.

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Both types easily cleaned or adjusted

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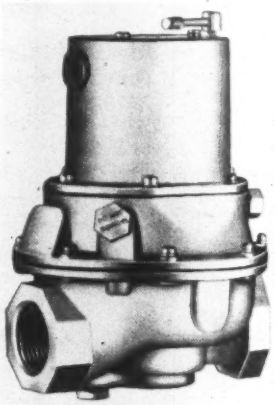
Small Coupling Is Flexible, Available in Aluminum

No. 4100**—Recommended for such applications as blower and exhaust fans, oil burning equipment and air conditioning units, "Flex-Ring" couplings are available from Smith and Serrell, Inc., 31 Clinton St., Newark 2, N. J.

Designed for conditions where a small, light weight flexible coupling is required, it is rated for loads up to 2½ hp. For speeds up to 5000 rpm it is made of aluminum and for higher speeds it is of steel construction.

According to the company, the center ring is replaceable without removing the hubs from their companion shafts. End sections are cast and are machined overall. For operation in a continuous oil bath, "Hycar" is substituted for rubber.

Diaphragm Gas Valve Has Packless Construction



No. 4101—The B-50 diaphragm gas valve for natural, manufactured, mixed, and liquefied petroleum gases is of packless construction with all body parts of die formed aluminum. The manufacturer is General Controls Co., 801 Allen Ave., Glendale 1, Calif.

With a current consumption of 5 watts, it may be used for low or line voltage applications. The size of the unit is said to make it easily adapted to any gas fired heating installation.

Available sizes are from ⅜ to 1½ in.

Controls Evaporation of Air Freshening Compound in Air Conditioning Systems

No. 4102—The Model AE "Osmetrol" system is a method for controlling the evaporation of "Airkem" air freshening compound and of introducing proper amounts of the vapor into air conditioning systems. The manufacturer is Airkem, Inc., 7 E. 47th St., New York 17.

The system is composed of three units: a controller, a reservoir and pump, and a vaporizer. The controller regulates the amount of liquid pumped from the reservoir to the vaporizer. By utilizing the "suction" of the air conditioning system fan, air is pulled through the vaporizer and picks up vapor which is mixed with the air and is delivered to conditioned spaces through the system ducts.

According to the company, the liquid compound contains two groups of volatile substances designed to provide air freshening. The new control system is designed for use on systems of up to 40 tons capacity. Other equipment is available for larger systems.

Uses Inboard Bearings on Rotary Pumps

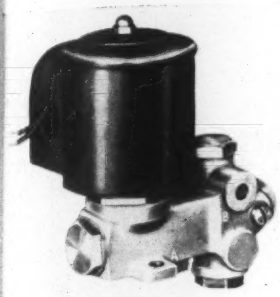
No. 4103—Worthington Pump and Machinery Corp., Harrison, N. J., has developed a new inboard bearing construction on its line of GR rotary pumps, designed to take the load off the main pump bearings and thus provide longer life and a more rugged pump.

The bearing is an adapter type unit designed so that

the inner race is locked to the drive shaft, close to the load center. This is said to eliminate necessity of the user installing separate outboard pedestal bearings and base.

This feature, says the company, also incorporates a drip-proof mechanical seal automatically adjusted and subject to suction pressure only, making this pump suited to high pressure or high vacuum services.

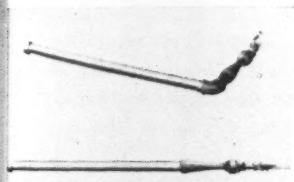
Three-Way Solenoid Valve Has Packless Construction



No. 4104 — Automatic Switch Co., Orange, N. J., has placed on the market a new series of Bulletin 8300 packless three-way solenoid valves which are designed for steam service up to 250 psi and 450 F.

The solenoid, operating through a power multiplying internal lever, is protected with brazed core tube joints which are said to provide the necessary seal for steam service. Coils are of either glass insulated winding or silicon winding. Valves are normally supplied with cast bronze bodies, though cast iron bodies may be obtained. Seats, discs, and springs are of stainless steel. Nominal sizes are $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{1}{2}$ in., and available enclosures include water tight, explosionproof, and standard types.

Pipe Burners May Be Turned Down Low Without Flashback

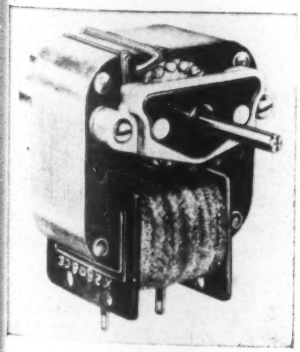


No. 4105—Three types of pipe burners, for manufactured, natural, or liquefied petroleum types of gas, are offered by Bryant Industrial Div., Affiliated Gas Equipment, Inc., 1020 London Rd., Cleveland 10.

Designed for efficient use of combustion air and for low turndown without flashback, the units are equipped with "Lojector" venturi mixers, with or without gas cocks. The burners are available with either single row or double row port drilling and a mounted torch pilot or spark plug ignition unit may be supplied if desired. Orifice spuds may be inspected or changed using only a screw driver and pliers.

Capacities range from 10,000 to 300,000 Btu per hr and burner sizes are from $\frac{3}{8}$ to 4 in. pipe.

Shaded Pole Motor Has Die-Cast Bearing Brackets



No. 4106—To hold the rotor in more perfect alignment with the stator core and avoid distortion due to impacts in handling, the "Raytheon" model 230 shaded pole, 3200 rpm motor is now equipped with new, rigid, die-cast bearing brackets. The manufacturer is Russell Electric Co., 340 W. Huron St., Chicago 10.

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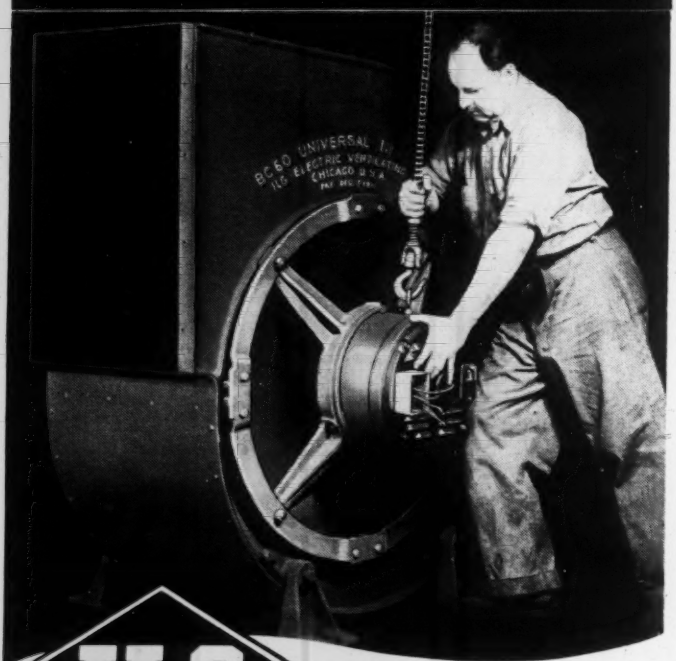

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It is also said to have 50 percent less rumble due to reduction of the eccentricity of the air gap. Ratings are from 1/190 to 1/75 hp continuous duty. The motor is available with two internal cooling fans, and dynamically balanced rotor.

Equipment Shorts

Coils of hot rolled steel are now being produced regularly at the plant of **Geneva Steel Co.**, Geneva, Utah, and are being shipped to the new cold reduction mill in Pittsburg, Calif., of **Columbia Steel Co.** In the California plant the steel is cold rolled to make sheets and tin plate. Both plants are subsidiaries of **United States Steel Corp.** In addition to the new line of coils, the Geneva plant, constructed during the war, is continuing its regular production of steel plates and structural mill products.

Reductions in net prices ranging from ½ to 7 percent on polyphase and d-c motors and generators from 1 to 200 hp have been effected by a new motor and control sales and discount plan of **General Electric Co.**, Schenectady, N. Y. In addition to list price adjustments, the plan extends greater discounts to most purchasers.

According to a recent announcement, the company's apparatus department has substantially returned to its pre-war price policies. For light equipment with a short manufacturing cycle, frequently purchased by future delivery orders, the company is protecting the purchaser on shipments made within 90 days after a price increase. This equipment includes industrial controls and induction motors from 1 to 200 hp. Many of the department's equipment lines are now being sold on the basis of the quoted price being maximum with a provision for downward adjustment in the event of general price reductions in the particular product line. These lines include switchgear, integral, d-c motors, synchronous motors, and induction motors above 200 hp, welding equipment, and mechanical drive turbines.

Refrigeration Engineering, Inc., Los Angeles, has issued a license to **Worthington Pump and Machinery Corp.**, Harrison, N. J., for the use of its water defrost method in refrigeration production. This agreement brings to 13 the number of manufacturers using this method which was developed in 1938 and patented in 1940. . . . **Knapp Supply Co.**, Muncie, Ind., recently celebrated its 75th anniversary. To mark the occasion, a descriptive booklet has been issued by the firm, wholesaler of heating, air conditioning, refrigeration, and industrial supplies.

The price of light gage stainless steel sheet has been reduced by **Washington Steel Corp.**, Washington, Pa. Starting with 27 through 36 ga, all gage extras are reduced. New methods of cold rolling on the Sendzimir mill are said to permit reductions from 11 to 26 percent. . . . For the enviable record of one million man-hours work time without a disabling injury, **Binks Mfg. Co.**, Chicago, has been awarded a plaque by Lumberman's Mutual Casualty Co. According to records of the National Safety Council, only six out of 1000 industrial plants are able to equal this record.

Acting as host to 3500 employees and guests at a dinner, **Leeds & Northrup Co.**, Philadelphia, celebrated its 50th anniversary. Morris E. Leeds, chairman of the

board, was presented with a gold 50 year service plaque and received a bound testimonial expressing the organization's esteem for its founder. . . . **Plibrico Jointless Firebrick Co.**, 1860 Kingsbury St., Chicago 14, has taken over the exclusive sale, engineering, and installation of the "Jet-Sets" overfire air system of **North American Mfg Co.** Designed to prevent smoke by the injection of secondary overfire air, it is now identified as the "PliOjet" system. Herbert A. Scruggs, formerly smoke commissioner for Jefferson City, Mo., and Kingsport, Tenn., heads the new department.

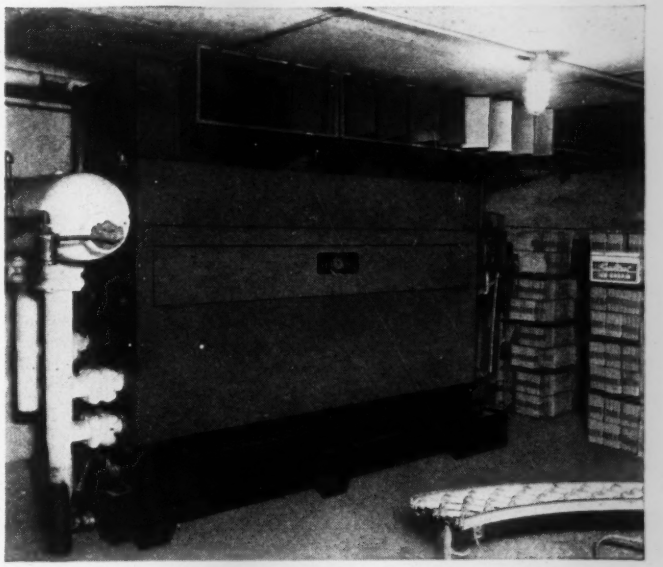
Koppers Co., Inc., Pittsburgh, has completed the coal gasification phase of the gas synthesis demonstration plant now under construction for the **Office of Synthetic Liquid Fuels, U. S. Bureau of Mines** at Louisiana, Mo. When completed, the plant will convert 28 tons of run-of-mine coal to approximately 80 bbl of synthetic liquid fuels per day using a synthesis gas, principally carbon monoxide and hydrogen, produced in the company's coal type gasifier and a modified Fischer-Tropsch synthesis process. The modifications employed are expected to adapt the process to the production of either motor gasoline or diesel fuel. . . . **Union Malleable Mfg. Co.** and its subsidiaries of Ashland, Ohio, have completed a modernization program designed to increase production and quality control of malleable iron pipe fittings, steel pipe nipples, and cast copper solder fittings.

Air Reduction Sales Co., New York City, has opened a new acetylene plant in Acton, Mass. Built to serve the New England area, it has a rated capacity of 100,000 cu ft per day. . . . The "Motorstoker," an automatic coal burner which conveys fuel from bin to burner and ashes from the burner to sealed containers, has been reduced in price 10 percent by **Hershey Machine and Foundry Co.**, Manheim, Pa. Improved manufacturing methods and lower material costs are said to make possible the reduction.

Palmer Mfg. Corp., Phoenix, Ariz., has purchased the Pacific and Superior heating divisions of **Naco Mfg. Corp.**, Los Angeles, a subsidiary of Grace Steamship Lines. "Pacific" and "Superior" heating equipment will be manufactured from the same dies, tools and patterns, developed by Naco. . . . **Fleck Co.**, Camden, N. J., distributor of heating equipment, pipe, valves, etc., recently held an open house in its new air conditioned show room.

Utilization of high frequency current to stabilize inert gas shielded arc welders is an important advance in welding. Radio interference, however, is a problem, and during the past year this has been studied by the **Joint Industry Committee on High Frequency Stabilized Arc Welders**. Recommendations have been made to the **Federal Communications Commission** which is scheduled to issue a ruling the end of this month.

All hourly paid employees of **Reznor Mfg. Co.**, Mercer, Pa., are now participating in a "share of production" plan which has been used successfully for a number of years by various companies. It is an incentive plan designed to enable employees to earn more pay for more productivity and more pay in line with higher prices without any



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COST - REDUCING
Refrigeration?

The Niagara "No Frost" Method saves you from any loss, delay, shut-down, or diminished efficiency from frost on your refrigerating coils, at any time. You always get the full capacity that you paid for when you bought your refrigerating plant.

See how this means money savings. You run with higher suction pressures and lower head pressures, saving power. Your wear and tear and maintenance is lower; you save the loss of production and the labor used in defrosting periods. You save the power that is wasted when refrigeration is supplied through coils that are frost-coated.

The Niagara "No Frost Method" is not just a means of defrosting. It is a means of operating refrigeration without the formation of frost at any time, reducing costs, quickly paying for itself.

There are hundreds of successful "No Frost" users who say it is saving money, increasing production and improving quality for them every day . . . in every type of refrigeration installation requiring temperatures below freezing . . . in food freezing, ice cream, cold storage and in special industrial applications.

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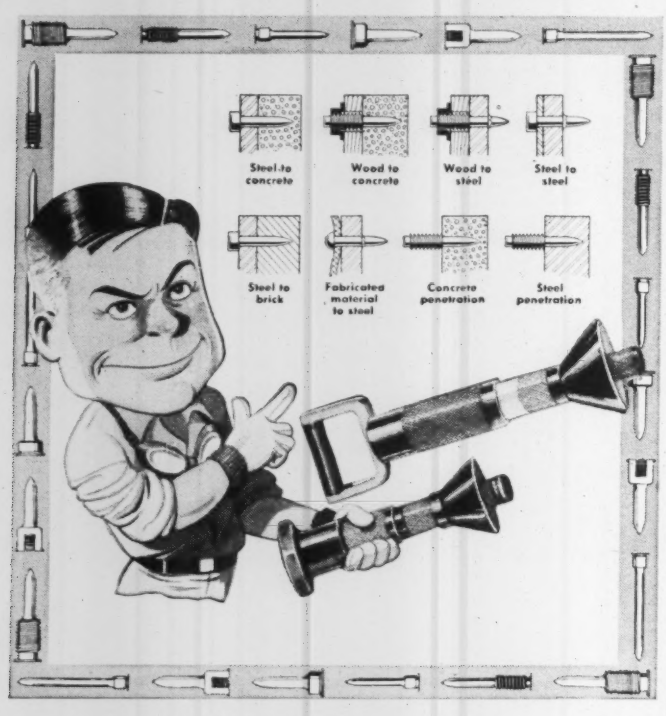

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Fastening jobs like those illustrated are all in a day's work for JOE RAMSETTER. With his light, self-powered RAMSET TOOL and 63 sizes of pins and studs, he can set up to 50 fasteners per hour, to cut costs and finish the job faster.

No chipping, no drilling, no plugging. No electric or air lines. Prepare the RAMSET TOOL in 30 seconds. Then, place it against the work and RAM! The fastener is set instantly, tightly, easily. We teach any alert, careful workman to "RAMSET", in 30 minutes.

For fastenings in steel, concrete and other hard-to-work materials, RAMSET pays big dividends in time and money. Use the coupon for complete information. *Stemco Corporation, Cleveland 16 (Rocky River), Ohio.*

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Please send details and arrange for demonstration of RAMSET FASTENING SYSTEM.

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increase in the hourly wage rates. It is said to reward employees for savings in material and supply costs and the reduction of waste in material usage. The plan also offers rewards for producing better quality finished units and the reduction of rejects and inferior workmanship. It is not a profit sharing plan because it pays workers fixed percentages of production values whether or not the company makes a profit.

Norma-Hoffman Bearings Corp., Stanford, Conn., has made available to users its Norma G-66 "Stability-Tested" grease for bearing lubrication. This ball and roller bearing grease is said to be highly resistant to oxidation, insoluble in water, and to provide lubrication over a wide range of temperature without separation, drying out, or hardening. . . . **Landis Machine Co.**, Waynesboro, Pa., has developed ½ and ¾ in. solid adjustable die heads for use on automatic machines for threading street ells and similar cast iron fittings where clearances are limited between the die head and the machine. The diameter of the die head is 3¾ in. and to provide further clearance, the chaser holders are beveled off on a 45 deg angle. . . . A low cost "Bru-Cex" water conditioner, said to lengthen the life of water systems and increase water softener capacity, is available from **Bruner Corp.**, 2318 N. 30th St., Milwaukee 10. The product, made from phosphate and packaged in crystal form, is added to any water system by means of a feeder installed on the water inlet. It is said to be effective in stopping equipment losses due to scale, rust, and corrosion and to control red water.

A "Dynetric" balancing machine is being used by **Westinghouse Electric Corp.** at Hyde Park, Mass., to dynamically balance large air moving assemblies weighing from 1500 to 25,000 lb to 0.000025 in. of linear movement of the floating bearings. The balancing machine was developed jointly with **Gisholt Machine Co.**, Madison, Wis. . . . **Chicago Nipple Mfg. Co.** has introduced a standard package line of pipe nipples. Some 93 different packs in each type and finish are available in standard quantities and sizes, ranging from ⅛ to 2 in. sizes and from close to 6 in. lengths.

Fundamental data supporting the performance of finned tubing as about "eight times better than plain tubing in heat exchange applications" has been reported by **Lehigh University Institute of Research.** Data were obtained from a cooperative research program with **David E. Kennedy Corp.**, Brooklyn, whose finned tubing was under test. . . . A single unit photoelectric smoke detector for plant and warehouse areas has been developed by **Walter Kidde & Co., Inc.**, 40 E. 34th St., New York 16. A continuous sample of air is drawn through an individual piping system into an analyzer tube where the air is filtered to remove dust and dirt and is then passed into a light beam focused on a photoelectric cell.

Syracuse Alloy Metals Corp., 116 S. Salina St., Syracuse 2, N. Y., has developed a new line of "Samco" cylinder carriers for welding service. These gas cylinder trucks are designed to provide speedy transportation with safety and minimum effort. Units are of welded construction throughout and are streamlined for rapid wheeling in confined spaces. . . . A miniature variable-ratio speed changer

has been developed by **Metron Instrument Co.**, 432 Lincoln St., Denver 9. Weighing less than 6 oz, it is designed to deliver up to 70 oz-in. torque and 0.025 hp. Possible applications are said to include recorders, controllers, computers, indicating mechanisms, and similar devices. The ratio of input to output speeds is infinitely adjustable between 1 : 6 increase and 6 : 1 decrease; with a total speed range of 36 to 1. According to the company, maximum output torque is obtainable at zero speed and operating speeds as high as 20,000 rpm are practical.

A new small automatic voltage regulator, rated at 2 kva output, has been developed by **Superior Electric Co.**, Bristol, Conn. Listed as the "Stabiline" type EM 4102, the regulator is electromechanical in operation and consists of a "Powerstat" variable transformer controlled by an electronic detector.

ASRE Members Hear of Steam Absorption Unit

A new steam operated absorption refrigeration machine has been developed in the capacity range of 100 to 200 tons for air conditioning and water chilling service. It is designed to deliver cold water at temperatures as low as 36 F, to be fully automatic, and to regulate at loads between 10 and 100 percent full capacity. Maximum consumption of either high or low pressure steam is said to be 19 lb per hr or less.

The history and theory of the absorption cycle are briefly cited and the development of this machine is covered in a paper by A. A. Berestneff, Carrier Corp., presented at the recent 36th spring meeting of the American Society of Refrigerating Engineers, 40 W. 40th St., New York 18. Information is given on design, operating, and construction features and charts provide physical and performance data.

According to the author, the selection of water as the refrigerant was logical because of its desirable thermal properties and because it can be used directly in a flash evaporator, avoiding the use of heat interchange surface between the refrigerant and the medium to be cooled. Lithium bromide, which forms a liquid solution with water and is physically harmless, nonflammable, and nonexplosive, is used as the absorbent. The machine is built in three sizes, 115, 150 and 200 tons nominal capacity and the normal rating point is at 45 F chilled water delivered and at 3½ gpm per ton of 85 F entering condensing water.

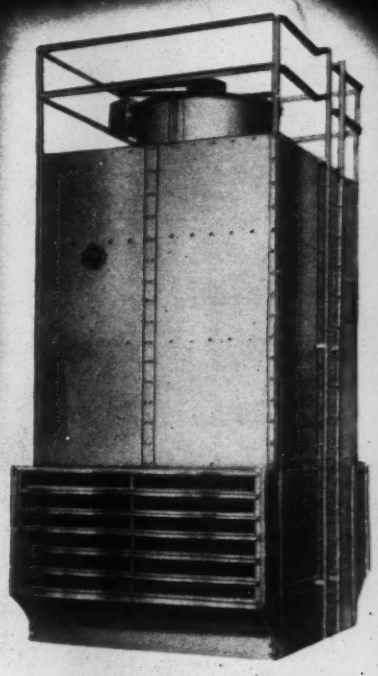
Mr. Berestneff said that the absence of vibration permits installation in almost any part of a building. Due to the flash evaporator the preferred location is above the top chilled water coils. This also brings the machine nearer the cooling tower. Location below the chilled water coils is feasible provided certain precautions are taken. The unit is not suitable for direct use with an open chilled water circuit, such as for air washer application, because the large amount of air carried into the machine by the water would require an excessively large purge and might interfere with heat transfer. Other reasons include the possibility of a corrosion problem and large quantities of dirt getting into the unit.

The author states that where electricity costs 1 cent per kwhr, the machine will have a lower operating cost than electric driven compressor machines whenever the cost of steam is less than 50 cents per thousand pounds.

NEW MARLEY *Verflow**

An "*Extra Quality*" Tower

. . . At No Extra Cost



The New Marley VERFLOW sets a new standard in air conditioning and refrigeration Cooling Towers.

Check these "extra quality" features formerly found only on heavy duty, industrial cooling towers that are now available on all Marley wood or steel VERFLOWS at no extra cost to you . . .

√ Lifetime nail-less filling. √ Filling that can be removed and reinstalled in a matter of minutes. √ Totally enclosed motors. √ Enclosed bearing housings with grease packed bearing. √ Marley air-foil section cast aluminum alloy fans. √ Special corrosion-resistant paint on metal towers. √ Heavy double-sheathed wood casing on wood towers. √ Patented, close-centered Marley jet action spray nozzles in balanced distribution system. √ Hinged louver frames and removable louvers. √ Quickly erected, easily operated with little maintenance time.

These and other "extra quality" features make Marley VERFLOW the best buy on the market. Many special accessories such as Geareducer drive, handrail and ladder are also available at a small added cost.

Ask your nearest Marley representative to tell you more about the VERFLOW or write for Bulletin V-49.

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Combustioneer
Has The
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WHICH CUTS
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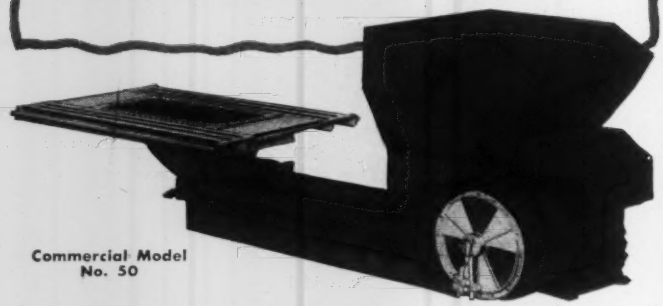

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No. 50

Combustioneer's Automatic Respirator, exclusive and patented, maintains at all times the precisely correct amount of air in the fire-bed for ideal combustion. There are no dampers or shutters in the air duct to adjust—operation is completely automatic. This assures maximum efficiency . . . *and cuts fuel costs up to 30%. Only* Combustioneer has it!

Combustioneer's exclusive "Pulsating" Transmission agitates the fire-bed, thoroughly mixing air and coal so that every particle is consumed. There is no waste. Its direct gear contact gives tremendous power. Its heavy-duty ruggedness assures long trouble-free service. Feed rate changes can be made easily while the stoker is in operation.

Twenty years of precision-engineering leadership have produced a complete line of hopper and bin-feed Combustioneers with capacities up to 1000 pounds per hour. They meet all heating needs in factories, shops, stores, theaters, hotels, apartment houses and other large private and public buildings.

Write today for the proof that a Combustioneer Automatic Coal Stoker can *cut your fuel costs!*

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WHO'S WHAT

Buffalo Forge Co., Buffalo, N. Y., has elected two new directors, increasing the total number from five to seven. They are **Charles C. Cheyney**, who continues as sales manager, and **Arthur M. Kiely** who is also controller of the firm . . . **Louis S. Morse, Sr.**, executive engineer of York Corp., is the first honorary member to be elected by the **Air Conditioning and Refrigerating Machinery Association.** As advisory engineer to the association's general standards committee for many years, he has been prominent in the development of ACRMA's equipment standardization program.

The new president of the **Western Society of Engineers** is **Gustav Egloff**, petroleum technologist and director of research for Universal Oil Products Co. Other officers recently elected are: first vice president—**H. P. Sedwick**, vice president, Public Service Co. of Northern Illinois; second vice president—**J. C. Witt**, Chicago consulting engineer; treasurer—**Donald N. Becker**, chief structural engineer, A. J. Boynton & Co. Trustees for three years are **Ludwig Skog**, senior partner, Sargent & Lundy, consulting engineers, and **L. F. Bernhard**, cost study engineer, Illinois Bell Telephone Co. The society has opened its new headquarters at 84 E. Randolph St., Chicago, where there has been established an engineering and science center for Chicago.

Westinghouse Electric Corp., Pittsburgh, has elected three new officers. **James H. Jewell**, manager of apparatus sales, and **John M. McKibbin**, assistant to vice president and manager of advertising and sales promotion, are new vice presidents. **Herbert P. MacDonald**, treasury manager in the company's eastern district office in New York City, is now assistant treasurer. He has also been named credit manager. Mr. Jewell takes over staff supervision of all sales and marketing. Mr. McKibbin is now general manager of consumer products. Vice Pres. **L. E. Osborne**, primarily an operations official heretofore, has been assigned staff supervision over all manufacturing activities and retains operating responsibility for five major manufacturing divisions. **John K. Hodnette**, vice president and head of the transformer division, is now general manager of industrial products.

G. D. Greensward is now general manager of the Norwood, Ohio, works of **Allis-Chalmers Mfg. Co.**, Milwaukee. He has been assistant to **W. C. Johnson**, executive vice president in charge of the general machinery division, and succeeds the late Frank H. Stohr. **Robert S. Fleshiem**, who has been managing the electrical department, has succeeded Mr. Greensward and **Roy M. Casper**, manager of the motor and generator section, has taken over the electrical department . . . **Frederick H. Blackmore**, vice president in charge of manufacturing, **United States Radiator Corp.**, Detroit, has retired after 49 years of service with the firm and one of its predecessors.

Worthington Pump and Machinery Corp., Harrison, N. J., has elected **Robert E. Marshall** secretary, succeeding the late C. Neal Barney. He has been with the company since 1947, serving as a member of the legal department, counselor on industrial relations, and assistant secretary.

. . . **Donald M. Alstrup,** assistant commissioner, **Federal Housing Administration,** is now serving as liaison officer with the prefabricated and industrialized housing industry. He has been working on the insurance of loans to prefabricators under Section 609 of the Housing Act, and his additional duties will include liaison contacts with industry representatives on general problems that may arise.

General Electric Co.'s air conditioning dept., Bloomfield, N. J., has appointed **John D. Hoffman** to the newly created post of manager of direct sales of air conditioning and commercial refrigeration products. He will be responsible for all sales activities to customers served direct. **H. N. McMenimen, Jr.,** is the new manager of distribution sales and is responsible for departmental activities through resale channels. **Harry J. Wines** has been named sales manager of the department's heating division. In the company's apparatus dept., Schenectady, N. Y., **James H. Goss** is now manager of engineering in the controls division.

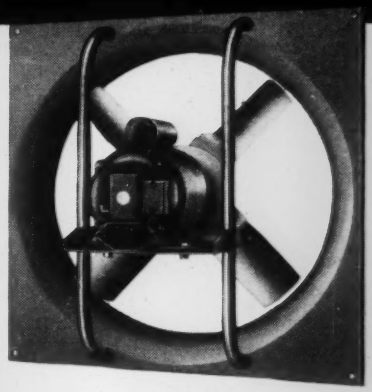
Stevens Institute of Technology has conferred the honorary degree of doctor of engineering on **John Van Brunt,** vice president of Combustion Engineering-Superheater, Inc. An honorary degree of mechanical engineer has also been awarded to **Henry M. Brundage, Jr.,** manager, automatic heating division, air conditioning dept., General Electric Co. . . . **Globe Steel Tubes Co.,** Milwaukee, has promoted **F. K. Krell,** formerly Chicago district sales representative, to manager of sales, welding fittings. **John F. Scott,** sales representative for the New York office, is now manager of sales, stainless and alloy tubing. **John Koss,** previously in charge of export sales, is now sales representative, Chicago district, and **J. J. Lukens,** formerly head of the pricing division, is sales representative in the New York district.

J. F. Roche, president since 1936 of **Binks Mfg. Co.,** Chicago, has been elected chairman of the board and is succeeded in the presidency by his son, **Burke B. Roche** who has been vice president since last year and has been in charge of the company's industrial division . . . The new manager of the market research section, trade analysis division, **E. I. du Pont de Nemours & Co.,** Wilmington, Del., is **Ambrose W. Staudt.** He is succeeded by **George H. Braniff** as manager of the nylon technical service section . . . **Wallace F. Hastie,** assistant manager of the Chicago sales office of **American Radiator & Standard Sanitary Corp.,** Pittsburgh, has been named manager of the San Francisco sales office. He has been with the company since 1938.

Robert T. Jones is the new manager of design and development for **Acme Industries, Inc.,** Jackson, Mich. He was formerly with Chrysler Corp., Airtemp Div., as supervisor of design and development and has also been associated with York Corp. **Roy C. Yantis,** formerly sales manager for Henry Valve Co., has joined Acme as regional sales director and will cover eastern states. **Charles King Carter,** long associated with the refrigeration and air conditioning industries, has joined the firm as sales engineer . . . **Ward Leonard Co.,** Mount Vernon, N. Y., has named **Central Station Engineering Co.,** 2817 Croyden Dr., Tucson, sales representative in Arizona.

Make a cool profit
THIS SUMMER
with FAN-PAC
PACKAGED VENTILATION

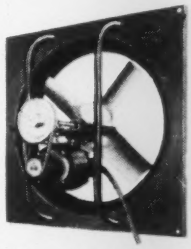
Ideal for
STORES
BEAUTY AND BARBER SHOPS
THEATRES
RESTAURANTS
LAUNDRIES, HOTELS
OFFICE BUILDINGS
TAVERNS



DIRECT MOTOR DRIVEN
Available in 16", 18", 20", 24" sizes.

Certified Ratings PFMA

Here's a valuable inside tip for cool summer profits! Business establishments everywhere seek ways and means of creating increased employee efficiency during hot, sultry weather. FAN-PAC is the answer, circulating cool, fresh air for more healthful, comfortable working conditions. Increased customer traffic and new patronage is also the result of FAN-PAC easy-to-install Packaged Ventilation. Cash in on this huge market! Build a bigger summer business for yourself by investigating FAN-PAC *TODAY!*



"V" BELT MOTOR DRIVEN
Available in 24", 30", 36", 42", 48" sizes.

Important FAN-PAC Features
1 Non-Overload Power Characteristic
2 Certified Wind Tunnel Capacities
3 Square Panel Mounted for Easy Installation
4 Scientifically Correct Air Inlet
5 Cushioned Motor Mountings for QUIET Operation
6 Motors of Nationally Recognized Make

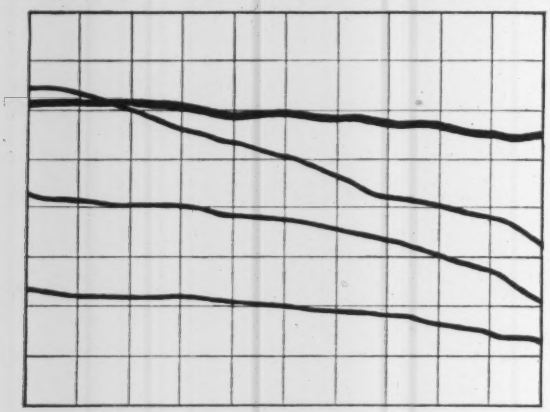
FREE FAN-PAC CATALOG! Send today for new catalog, complete with illustrations, specifications and capacities.

DeBothezat Fans Division, Dept., H-5
AMERICAN MACHINE AND METALS, INC.
East Moline, Illinois

Please send, without obligation, new FAN-PAC Packaged Ventilation Catalog.

Firm _____
Address _____
City and Zone _____ State _____
Sender's Name _____

THE LOWDOWN ON INSULATION



Efficiency is as efficiency does

Remember the old saying—"Handsome is as Handsome does"? Just change that word "handsome" to "efficiency," and you're talking about low-temperature insulation.

The smart insulation buyer realizes that theoretical or laboratory efficiency isn't the whole story, by any means. He wants his insulation to keep on delivering efficiency in his cold-room walls.

One of the grand things about Novoid Corkboard insulation is the dependable way it stays efficient year after year in actual service. Our customers keep coming back for more. (Satisfaction—not force of habit—is the reason for that.)

Of course, Novoid Corkboard is made here in the United States, under strict quality control. And it's installed by some of the most experienced, dependable men in the business. It's about as good a way to keep refrigeration costs down as you can possibly find. If conflicting insulation claims are bothering you, just write to us. We'll be glad to send you the "lowdown." Novoid Cork, Englewood, N. J.

Consider EVERY factor when you buy insulation

Check list of insulation properties

	Novoid Cork Insulation	Many Other Insulations
First cost	moderate	low to high
Installation cost	low	moderate to expensive
Eventual cost	low	high
Efficiency	remains high	generally deteriorates
Moisture resistance	excellent	some good, some poor
Vapor seal	simple	complicated or difficult to install
Structural strength	very good	some non-existent, others fair
Weight	very light	varies
Resilience	considerable	from fair to complete rigidity
Settling	none	a serious problem
Supporting structure	none	elaborate
Fire resistance	good	excellent to poor
Vermin resistance	good	excellent to very bad
Odor absorption	none	some are regular sponges

Youngstown Sheet and Tube Co., Youngstown, Ohio, has promoted **George L. Williams** to assistant manager in charge of the order department's western division in Chicago. **Dave Lewis**, supervisor in the department, has also been named assistant manager for the eastern division with offices in Youngstown. **Fred C. Dyer**, department clerk, is now chief clerk . . . **Combustion Engineering-Superheater, Inc.**, New York, has made four appointments in its sales department. **Walter Springe**, for many years district manager in Kansas City, is now division manager with headquarters in Kansas City, Mo. New district managers and their territories are: **C. J. Grossi**, Tulsa, **T. E. McMahon**, Kansas City, and **W. J. Woodruff**, St. Louis. Mr. McMahon was formerly in the Philadelphia office.

At the recent summer meeting of the **Hydraulic Institute**, awards were made to **A. M. Shaw** and **Roy Carter** of Worthington Pump and Machinery Corp. for their papers entered in the institute's engineering essay contest. Mr. Shaw's paper on phenomena of viscous flow was judged second in the technical group. Mr. Carter was awarded first prize in the practical papers group for his report on starting torque characteristics of centrifugal pumps . . . **Dale Cook** is now manager of the industrial controls division, **Perfex Corp.**, Milwaukee.

W. B. Connor Engineering Corp., New York, has appointed the following distributors for its apple and pear storage units: **Richard D. Lyman**, Albion, N. Y., western and northern New York; **Jersey Fruit Products Co-op Association, Inc.**, Freehold, N. J., New Jersey and Delaware; **Hill Top Orchards and Nurseries**, Hartford, Mich., Michigan and Northern Indiana; **Shantz Orchards**, Orefield, Pa., eastern border counties of Pennsylvania; **Growers and Producers Exchange, Inc.**, Roanoke, Va., southern Virginia and southern West Virginia; **Sho-Off Orchards**, Peoria, Ill., northern Illinois and Wisconsin . . . **Arthur B. Pike**, insulation sales engineer for **American Structural Products Co.**, a subsidiary of Owens-Illinois Glass Co., Toledo, has been assigned to the New England territory. With headquarters at 1227 Statler Office Bldg., 20 Providence St., Boston, he will cover Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, and part of Connecticut. Prior to joining the company this year, he had been a manufacturer's agent in the Boston area.

Auer Register Co., Cleveland, has named **L. J. Krause Co.**, Minneapolis, factory representative and distributor for the territory of Minnesota, North and South Dakota, Nebraska, and western Wisconsin. Mr. Krause was previously with Minneapolis-Honeywell Regulator Co. in various capacities . . . The new general sales manager of **Palmer Mfg. Corp.**, Phoenix, Ariz., is **Leetate Smith** who formerly handled training and sales programs for some of the larger fraternal insurance companies . . . **Harry F. Haldeman, Inc.**, Los Angeles, is the southern California distributor for the gas boiler manufactured by **Hook & Ackerman, Inc.**, New York City . . . **J. H. Ferguson** has been named district manager of the Akron, Ohio, branch office of **Bristol Co.**, Waterbury, Conn. He joined the company as a sales engineer in 1923 and since 1940 has been in the Washington, D. C., office.

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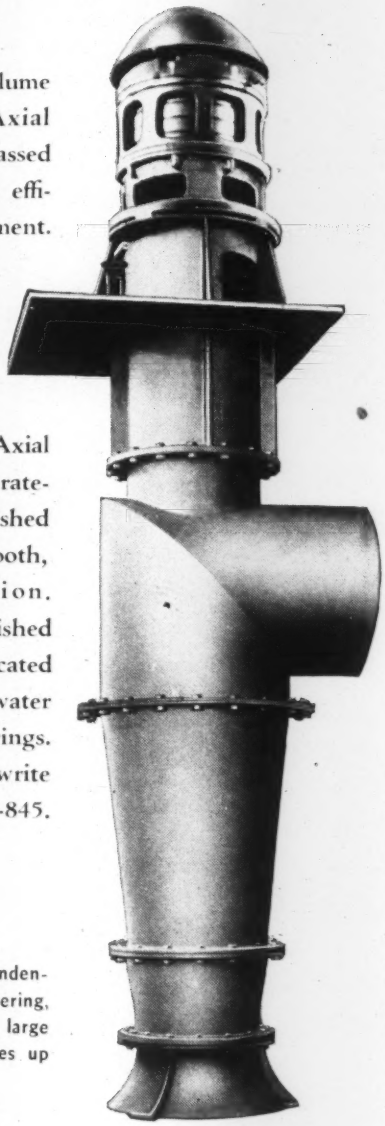
for your ***MAN SIZE*** *pumping jobs*

Economy
AXIAL FLOW PUMPS



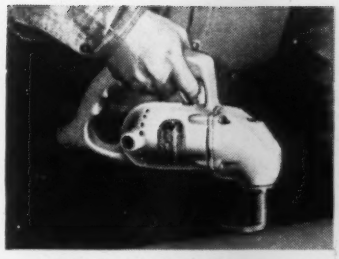
For low-head, large volume pumping, Economy Axial Flow Pumps are unsurpassed by any other type of efficient pumping equipment. Designed for either horizontal or vertical settings, these pumps are simple in design, compact in construction, and low in cost. Axial Flow propellers are accurately machined, hand finished all over, balanced for smooth, trouble-free operation. Pumps can be furnished with oil or grease lubricated metallic bearings or water lubricated rubber bearings. For complete details write Dept. C-7 for Bulletin G-845.

Especially suited for condenser circulation, dewatering, drainage and other large volume jobs. Capacities up to 200,000 G.P.M.

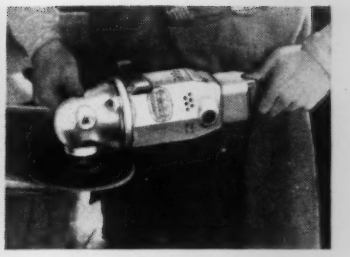
CENTRIFUGAL, AXIAL, and MIXED FLOW PUMPS for all applications.

Economy Pumps Inc.

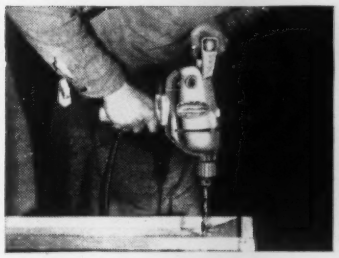
DIVISION OF HAMILTON-THOMAS CORP.
HAMILTON, OHIO



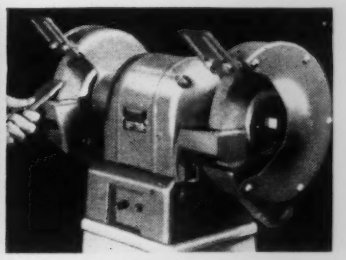
B&D Electric Porto-Shear cutting 16-gage stainless steel. Cutting action always visible to operator.



Versatile B&D Sander smooths cabinet corner. Same tool grinds wire brushes, planes wood.



B&D ½" Standard Drill drilling holes in 10-gage frame. Other B&D Drills from ¼" to 1¼" capacities.



Fingles uses a B&D Bench Grinder for grinding down welds, beveling stainless steel edges, sharpening tools.

The way to solve *more* tooling problems . . .

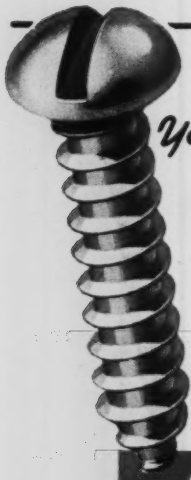
BLACK & DECKER
the world's most diversified line of Portable Electric Tools!

By *standardizing* on Black & Decker Tools, The Fingles Company of Baltimore, Md. has saved time and money on scores of jobs like these. As a custom sheet metal shop, Fingles needs versatile tools to handle a wide range of jobs in the shop and on outside installations. Black & Decker "universal" tools give them this versatility—plus expert repair service from a convenient B&D Factory Service Branch to keep their tools in top production form. And *every* B&D Tool is quality-built, engineered and powered to *turn out better work, with less effort, at lower cost!* See your nearby B&D Distributor for free demonstrations. Write for detailed catalog to: The Black & Decker Mfg. Co., 628 Pennsylvania Ave., Towson 4, Md.

LEADING DISTRIBUTORS EVERYWHERE SELL

Black & Decker
PORTABLE ELECTRIC TOOLS

OTHER BLACK & DECKER TOOLS used by The Fingles Co. include Electric Hammers for cutting mortar out of joints to install flashings and for drilling holes in concrete and brick; Electric Tappers for assembly work; Portable Grinders for grinding down welds where the tool must be brought to the work.



You GET CORROSION RESISTANCE

Plus

FAST ECONOMICAL ASSEMBLY

with these ELCO SCREWS

STAINLESS STEEL
ALUMINUM
BRASS BRONZE

HOLDING POWER

Elco fasteners made of stainless and other non-ferrous materials not only give corrosion resistance, but also holding power under continuous tension, because they are made from carefully analyzed materials, maintained from constant sources.

UNIFORMITY

Elco heads, threads and slots are made consistently alike under a system of rigid production control. This is assurance against defects and costly delays.

FAST ASSEMBLY

Quick, easy-starting points with accurately formed heads threads and slots, qualify Elco fasteners for mechanical pick-up and driving. Hours of handling time are saved.

SERVICE

After the assembly job is done, Elco service carries on. Strong hardened threads stay tight and rattle-free longer, permit removal and replacement, without danger of stripping, damaging or reducing the fit.

Why not write today and inquire about Elco screws to meet your requirements. Send for new catalog No. 48.

ELCO Screws

ELCO TOOL AND SCREW CORPORATION

1920 BROADWAY ROCKFORD, ILLINOIS

WOOD SCREWS • MACHINE SCREWS • MACHINE SCREW NUTS
DRIVE SCREWS • CAP SCREWS • LAG SCREWS • SPECIAL SCREWS
TAPPING SCREWS • STOVE BOLTS • PIPE PLUGS

C. W. Colby has been elected executive vice president and a director of **Thermek Corp.**, Chicago. He has an unusual background in the heat exchange and air conditioning industries and in recent years has been head of heating research for A. O. Smith Corp., in charge of its Whitewater, Wis., laboratory, which is now also available to Thermek and its licensees through Colton Corp. of which Mr. Colby is a director . . . As the new chief engineer of **Peabody Engineering Corp.**, New York, **A. P. Olches** will continue to direct engineering and research. He has been with the firm since 1928, more recently as manager of research and development.

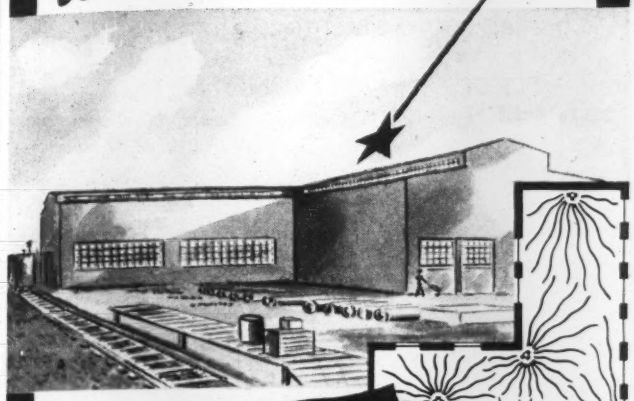
Rowland J. Miller, who joined **Clayton & Lambert Mfg. Co.**, Louisville, last year as a sales manager, is now vice president and general sales manager. He has many years of experience in the heating and refrigeration equipment fields . . . The Los Angeles branch office of **Tube Turns, Inc.**, Louisville, has been moved to Suite 447, General Petroleum Bldg., 612 S. Flower St. **Norton P. Bosemer** is in charge . . . **Philip W. Olmen,** Chicago, is the newly elected president of the **Sheet Metal Contractors' National Association.** Other 1949 officers are: **W. A. Wiedenmann,** Kansas City, 1st vice president; **Frank Kramer**, Milwaukee, 2nd vice president; **E. B. Brown, Jr.**, Chicago, 3rd vice president; **C. M. Gundlach,** Sandusky, Ohio, treasurer; **L. L. Stefanik,** Milwaukee, sergeant at arms; **J. D. Wilder** continues as executive secretary.

At recent ceremonies, **Allegheny Ludlum Steel Corp.**, Pittsburgh, presented company awards to a number of employees. Among the winners was **Louis Zaccagnini**, melter in the electric furnace department of the Watervliet, N. Y., plant, who was rewarded for increasing the yield from stainless and other high alloy steel ingots . . . **P. B. Gordon,** a prominent member of the American Society of Heating and Ventilating Engineers, has been elected a director of the **Technical Societies Council of New York, Inc.** . . . **White-Rodgers Electric Co.**, St. Louis, has appointed **Arnold E. Peterson** manager of its northeastern division, with headquarters in New York City. **E. E. Harwood** is now in charge of the Pittsburgh district.

All officers and Class B directors of **Bituminous Coal Research, Inc.**, Pittsburgh, have been re-elected. Officers are: president—**J. B. Morrow,** Pittsburgh Consolidation Coal Co.; 1st vice president—**R. H. Sherwood,** Central Indiana Coal Co.; vice president—**R. D. Stockdale,** Red Jacket Coal Sales Co.; vice president and director of research—**Dr. H. J. Rose;** treasurer—**M. L. Garvey,** Pocahontas Fuel Co.; treasurer—**C. A. Reed;** assistant secretary-treasurer—**J. F. Hanley.** . . Covering the state of Indiana and working under the supervision of the Chicago branch sales office, **W. H. Dwyer, Jr.,** is now sales representative for **National Radiator Co.,** Johnstown, Pa. **Byron R. West** has been named sales representative of the Washington, D. C., branch sales office.

As the new advertising manager of **Fedders-Quigan Corp.**, Buffalo, **George L. Drake** will work with several sales managers in directing the firm's advertising program . . . **Viking Air Conditioning Corp.**, Cleveland, has named **Roger Laubach & Associates,** 813 N. Brauer St., Oklahoma City, representative in the Oklahoma, Kansas, Arkansas,

How much would you say it cost to heat this Plant?



Less than 1/2 cent per cu. ft.?

About 3/4 cent per cu. ft.?

9/10ths of a cent per cu. ft.?

You wouldn't think there could be such a spread in the cost of heating a simple industrial structure—but an actual installation* figured out just that way! Coal fired pot bellied stoves cost 9/10ths of a cent per cu. ft.—additional boiler capacity, with necessary piping and diffusers figured at about ¾ cent per cu. ft. THERMOBLOCS to heat the structure cost .0044. All figures were based on a 15 year write off!

It's easy to see why THERMOBLOC presents such fundamental economy. Direct heat transfer, direct heat distribution—elimination of piping and duct work, automatic operation—all add up to economy.

PROVE IT YOURSELF!

To assist you in figuring heating requirements, THERMOBLOC has prepared a new bulletin containing engineering data tables and standard information on heating constants, building materials, etc. With this bulletin you can estimate the number and size of THERMOBLOCS to supply the necessary heat load, and you can make accurate forecasts of fuel consumption!

**Facts are from an article titled "Direct-Fired Unit Cuts Heating Costs"—printed in OPERATING ENGINEER, Nov., 1948. Copy of the article will be sent upon request.*

THERMOBLOC DIVISION
PRAT-DANIEL CORPORATION
Manufacturers of Thermix Power Equipment

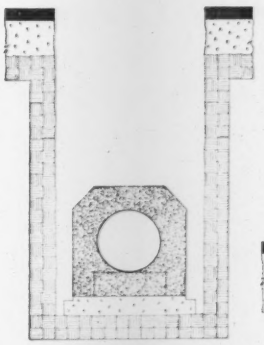
70 Water Street
East Port Chester, Conn.

FAST! SIMPLE! ECONOMICAL! EFFICIENT!

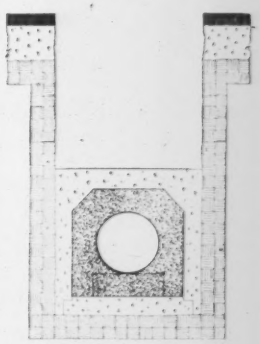
ARMORED INSULATING CONDUITS FOR HEAVY TRAFFIC AREAS USING "Z"crete

Cast-in-Place Insulation

The simplest yet most efficient solution to installations where traffic loads exist or where streets are frequently torn up. Ideal for underground installations because it will not disintegrate or deteriorate from wetting, exposure or electrical currents. "Z"-crete is permanent.



STEP ONE
at left
Steam main on pre-cast pipe supports rests on a structural concrete pad. Line is tested and a parting medium applied. Then the "Z"-crete concrete is poured, forming a solid blanket of insulation.



STEP TWO
at right
The insulating concrete is next encased in a water-repellent structural concrete. The result is practical insulation underground where trenching operations are expected.

"Z"-crete Insulating Concrete

Specially graded and mixed for underground insulation of steam, hot water and processed liquids. Furnished and installed by authorized applicators under rigid supervision. Write today for full information.

"Z"-CRETE DIVISION
ZONOLITE COMPANY
135 S. La Salle St., Dept. HP-79, Chicago 3, Illinois

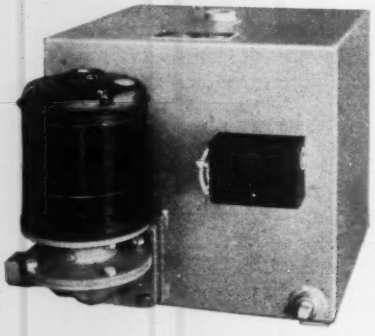
BEST ALL ROUND FOR YOUR UNDERGROUND!

A HIT from the start! the Sterlco 4100 SERIES CONDENSATION PUMP

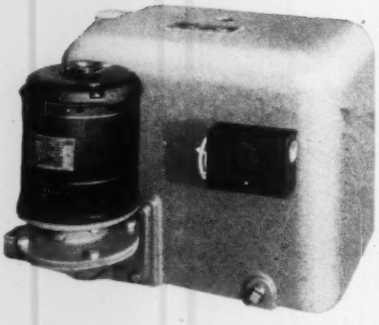
The popularly priced 4100 Series pump, the newest addition to our complete line of condensation pumps, has really "hit the bullseye" with users. Its compactness and neat appearance, its simplicity and sturdiness of construction, its conservative rating for handling emergency overloads, have all contributed to its enthusiastic acceptance.

Before you specify or buy a small condensation pump, be sure to find out about the many quality features of the 4100! The coupon below will bring full information.

The 4100 Series is particularly attractive as a stock unit. Wide range of capacity and pressure ratings in one unit eliminates stocking number of pumps. Requires less than 2¾ sq. ft. of storage space, stacks conveniently.



Sterlco 4100 Series Condensation Pump with steel tank. ¼ H.P. capacity up to 6000 sq. ft. E.D.R. at 20 lbs. Also ½ H.P. unit for 8000 to 14000 sq. ft. at 20 lbs.



New Sterlco 4200 Series unit, for jobs where cast iron tank is preferred. Same ¼ H.P. pump as the 4100—for 6000 sq. ft. maximum capacity, 20 lb. pressure.

All STERLCO products are distributed through leading heating and plumbing wholesalers.

Mail Now

STERLING, INC.

3732 N. HOLTON STREET • MILWAUKEE 12, WIS.

GENTLEMEN: Please send me complete information on Sterlco Condensation Pumps.

Name.....

Firm.....

Address.....

City.....Zone.....State.....

LOOK AT SOME OF THESE OTHER

Sterlco PRODUCTS

Condensation and vacuum pumps

Heating specialties

Temperature controls

and Amarillo, Tex., territory. Mr. Laubach was formerly assistant sales manager of the propane gas equipment division of Black, Sivalls & Bryson, Inc. . . . **Ralph H. Heberling,** vice president in charge of manufacturing, **Edward Valves, Inc.,** Chicago, has retired. He joined the firm in 1942 as assistant to the president.

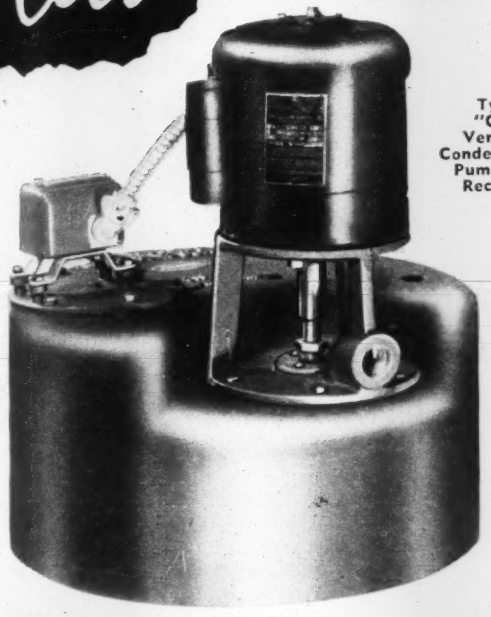
Frederick H. Mason Co., 1916 Ford Bldg., Detroit 26, has been sales and engineering representative of Cochrane Corp., Philadelphia, since 1900 and has handled a variety of water conditioning specialties. The firm is now also handling the Cochrane condensate drainage control system in the Michigan territory and the area surrounding Toledo. **Philip J. Berry, Robert M. Weaver,** and **S. Sutterfield** serve the territory . . . **Dr. Howard E. Fritz,** vice president-research of B. F. Goodrich Co., is the 1949 winner of the Lamme Medal of **Ohio State Unipersity.** The yearly award is made to a graduate of the school's technical department for "meritorious service in engineering of the technical arts." Dr. Fritz has pioneered in the adoption of rubber lined steel products for handling corrosive liquids.

Richard N. Chapin, assistant purchasing agent since 1945, has been promoted to general purchasing agent of **Air Reduction Sales Co.,** New York. **S. S. Stewart** has been moved from assistant to purchasing agent for the firm's manufacturing division . . . **Edward H. Paul** has resigned from Clayton & Lambert Mfg. Co. and has set up his own organization, **Edward H. Paul Sales Co.,** Middletown, Ohio, as a manufacturers' agent. Territory to be covered includes Ohio, Kentucky, Indiana, Michigan, northern West Virginia, and northern Pennsylvania . . . **Kenneth Lindquist** has joined the sales force of **Research Products Corp.,** Madison, Wis., and will cover some of the north central states. He was formerly assistant advertising manager of Gisholt Machine Co.

W. A. Kuechenberg, president, R. B. Hayward Co., Chicago, has been named chairman of the labor relations committee of the National Sheet Metal Contractors Association, with **H. James Murray** as co-chairman. **Otto A. Wendt,** Chicago, has been appointed advisory member to committees. **Louis L. Narowetz,** Chicago, honorary chairman of the association's labor committee, is heading a special committee of five men to formulate a plan regarding a welfare fund for sheet metal workers. . . . **W. C. Zingheim,** who has represented **C. A. Dunham Co.,** Chicago, for many years, has "asked the cooperation of the firm in effecting his retirement from the heating business." Accordingly, the company has established a Chicago sales and service office at 317 W. Huron St. **George A. Mansinger** is in charge.

Hamilton-Thomas Corp., Hamilton, Ohio, has elected **E. E. Baker** vice president of its public works pump division and **W. G. Rosendahl** vice president of its machine tool division. Mr. Baker has long been associated with the pump industry and came to the Economy Pumps division of the firm in 1945 as manager of distributor sales . . . **Clayton Distributing Co.,** Second Unit, Santa Fe Bldg., Dallas 2, is now a franchised distributor in that area for **Coroaire Heater Corp.,** Cleveland, and its wholly owned subsidiary, Hot Boy, Inc.

New SMALL PUMP



Type "CV" Vertical Condensation Pump and Receiver

BIG Performance

Introducing the new Skidmore Vertical Condensation Pump, so small . . . so compact, yet offers so much for so little. The wide range and selectivity at small investment, plus Skidmore's proven popularity makes this small vertical unit a real favorite! It will pay you to look further into the BIG PERFORMANCE of this low price dependable pump.

The Skidmore Type "CV" Condensate Pump is ideal for returning condensate to the boiler or other points, from all types of low pressure steam heating systems or process equipment, with capacities ranging from 500 to 10,000 sq. ft. Write for bulletin No. 21V.

Manufacturers of Quality Pumps for Over a Quarter of a Century

SKIDMORE PUMPS

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McCORD

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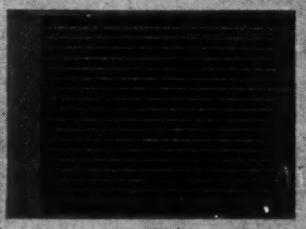
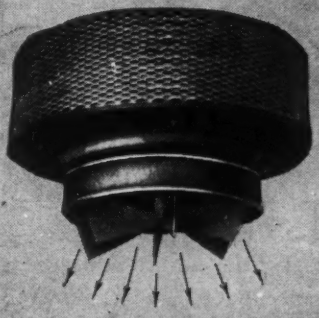
BLAST HEATING COILS—AIR CONDITIONING COILS—ALL TYPES



All copper spiral fin tube construction with the tubes formed or bent permits uniform expansion without strain. Headers are heavy wall construction with tubes brazed into extended ferrules formed in the headers. Fins are helically wound and metallically bonded. May we send catalog?

VERTICAL TYPE UNIT HEATERS



A proven heating unit, modern in design, incorporating every unit heater advancement. McCord copper spiral fin tube construction creates air turbulence without undue restriction. Improved fan blades deliver large volume of air with minimum air noise. Guaranteed for 150 lbs. saturated steam pressure. Specify McCord.

HORIZONTAL TYPE UNIT HEATERS

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Save fuel with McCord Unit Heaters.

McCord CORPORATION

DETROIT 11, MICH.

Type UH Gas-Fired Unit Heater —
From 180,000 to 540,000 Btu input capacities with exclusive "Heat-Speeder" steel heat exchanger. Type UH-109 also available — 67,500-135,000 Btu input capacities.

Mueller Climatrol fuel-thrifty Unit Heater

— your answer to gas-fired commercial heating problems

Here's a flexible design that helps you meet the requirements for all sizes of jobs for commercial heating, from garages and shops to larger factories and stores. Unit capacities increase at moderate increments by the addition of extra "heat speeder" heat-exchanger sections, allowing you to offer a unit that is economically close to exact requirements on any job.

And you'll offer years of efficient, fuel-thrifty service which is engineered into every Mueller Climatrol design. That combination always wins!

Push the UH Unit-Heater for more jobs and more profits. Write for complete details on this and other units in the complete Mueller Climatrol line. *L. J. Mueller Furnace Co., 2022 West Oklahoma Avenue, Milwaukee 7, Wisconsin.*

MUELLER E-40

Climatrol

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NEW BOOKS & REPORTS

ASRE Standard for Testing, Rating Conditioners Improved

In 1945, the Air Conditioning and Refrigerating Machinery Association made a formal request to the American Society of Refrigerating Engineers for a revision of the latter's Standard No. 16 with the following specific recommendations:

That the revision provide a practical calorimetric method of testing air conditioning units.

That calculations in the Standard be reviewed.

That consideration be given to the use of a calibrated compressor as one form of confirming test.

That consideration be given to a determination of air flow as a secondary quantity and to a more direct measure of capacity.

That the revised form of this Standard be similar to the form of the proposed revision of ASRE Standard No. 25.

That a statement be made as to the air quantity used in rating units on those units which have means for adjusting air quantity and perhaps that it be tied up with an acceptable noise level.

That air flow might be more specific.

The result of this request is the new proposed ASRE standard No. 16-R, Methods of Rating and Testing Air Conditioners.

The proposed standard combines the material in the original Standards No. 13 and No. 16. The arrangement, apparatus, and testing procedure are improved and both cooling and heating functions of self contained units, room conditioners, remote type conditioners, heat pumps, and oil and gas fired conditioners are covered. Copies may be obtained from ASRE headquarters, 40 W. 40th St., New York 18, for 50 cents.

Revises Authoritative Text on Metallurgy of Welding

The metallurgy of iron and steel is often regarded as consisting of two parts; process metallurgy, which involves the reduction of iron from its ores, further refining, casting, working, and shaping, and physical metallurgy which includes heat treatment, testing, metallography, and numerous other subjects. In their book, Welding Metallurgy, O. H. Henry, professor of metallurgical engineering, Polytechnic Institute of Brooklyn, and G. E. Claussen, formerly adjunct professor of metallurgy, Polytechnic Institute of Brooklyn, and metallurgist, Reid-Avery Co., state that of all branches of engineering metallurgy is the closest to welding. Accordingly, this text, first published in 1940, is intended to familiarize members of the welding industries with the composition and structure of the steel they use, to show how steel is affected by various conditions of heat and stress in welding, to explain the mysteries of heat treatment, and to point out the way in which metallurgy can be used to control the welding process.

A second edition, revised by G. E. Linnert, Armco Steel Corp., has recently been issued by the American Welding Society. It has been brought up-to-date and includes new information on processes which have been introduced during the past eight years, such as inert gas-metal arc welding and the metallurgy of stainless, heat resisting, and stainless clad steels.

Containing over 500 pages, 5 x 7½ in., the book is clothbound and is priced at $2.50. Copies are available from AWS headquarters, 33 W. 39th St., New York 18.

UNIVERSITY OF MICHIGAN LIBRARIES

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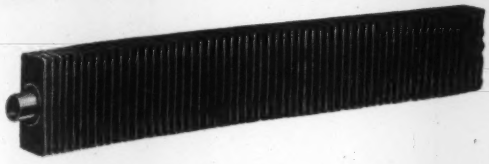
"RADI-VECTOR"



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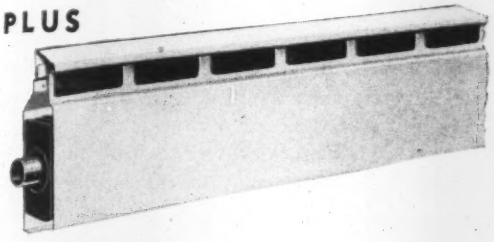
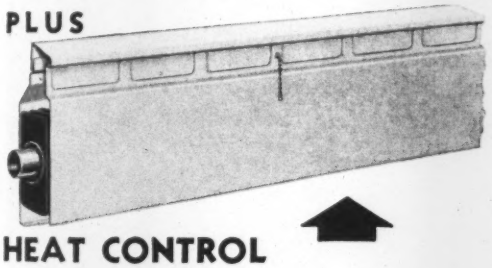


FS FRONT

Vulcan type FS Front, modern and attractive in design, directs convection currents away from immediate contact with wall surfaces preventing high concentration of dust particles where smudging conditions may exist — adds radiant heating surface for floor level comfort.

PLUS



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An entirely new feature in Baseboard Radiation, it permits control of heat in individual room units — to suit individual heat preference. (optional)

. . . Makes **VULCAN "RADI-VECTOR"** the most attractive Baseboard installation, the smoothest heating, for modern homes.

Ask your nearest Vulcan Representative for a copy of Vulcan Baseboard Bulletin #52.

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RADIATOR MANUFACTURERS FOR OVER TWO DECADES

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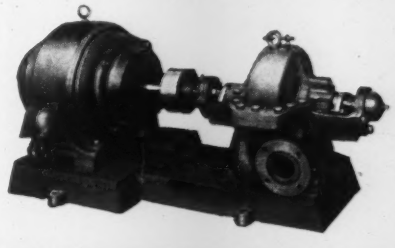
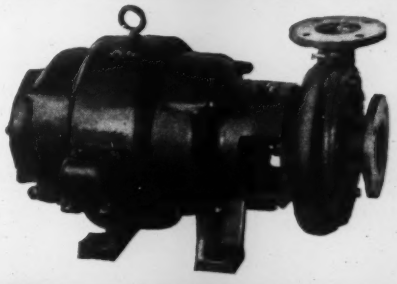
Whenever you have a pumping problem, the name to remember is WEINMAN. WEINMAN pumps are designed and manufactured by Centrifugal Specialists. These men are concerned with but one product . . . pumps, and one objective . . . making them work at maximum efficiency on every job.

For day-in, day-out, trouble-free service, you can't beat WEINMAN pumps. If your plant handles liquids in any form, it will pay you to talk with WEINMAN. A letter, telegram or 'phone call will get the prompt attention of a Centrifugal Specialist . . . anxious and able to help.



WEINMAN Type JC High Head SPLIT-CASE Pump. Two Stage back to back impeller design. Capacity up to 600 G.P.M., heads to 600 feet.



WEINMAN General Service UNIPUMP. Used where space is limited. Can be mounted in any position. Capacity to 1000 G.P.M., heads to 500 feet.

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The WEINMAN Pump Mfg. Co.
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MORE YEARS OF SERVICE!

15 to 20% Heavier Than Any Similar Class Construction . . . AND Competitively Priced

Design-engineered for maximum effectiveness, low operating cost and quietness. Furnished with backward or forward curved wheels in Class I to Class IV construction. Available in all drive arrangements and directions of rotation and discharge. Air deliveries from 600 to 260,000 CFM at from ⅛ to 16" static pressure. Wheel diameters from 12 to 73". Special coatings or stainless steel for acid applications.

Housings, ⅛" to ¼" plate steel, continuous-weld construction.
Inlets, heavy spun-steel, venturi shape.
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Supports, ½" x 3" bar stock, welded to housing.
Wheels, all heavy plate welded construction, dynamically balanced.
Bearings, extra heavy duty, single or double, self-aligning pillow blocks.
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Says Air Cycle Refrigeration A Logical Choice for Aircraft

Because high rotative speeds and high power requirements are more than offset by simplicity, light weight and the small amount of space required, air cycle refrigeration can more logically be applied to aircraft than any other form of refrigeration. This conclusion is expressed by Paul C. Scofield, project engineer, air conditioning, AiResearch Mfg. Co., in his paper on air cycle refrigeration, presented at the 36th spring meeting of the American Society of Refrigerating Engineers, 40 W. 40th St., New York 18.

Pointing out that air cycle possibilities were not exploited until after conditioning of aircraft became an established field, the author describes the advantages of various types of installations in current planes. In the Lockheed Constellation plane the space requirement is about 25 percent less than that required for a "Freon" system and the weight advantage is even more pronounced. In addition, there are a number of other advantages. Since air is the refrigerant, small amounts of leakage are often more tolerable. In its simplest form, the system requires only one heat exchanger; the evaporator being eliminated because the expanded refrigerant is introduced directly into the space. For military applications, availability of the refrigerant is important. The cycle can be used in conjunction with cabin supercharging equipment as cabin pressurization is required at high altitudes and refrigeration requirements are highest at sea level.

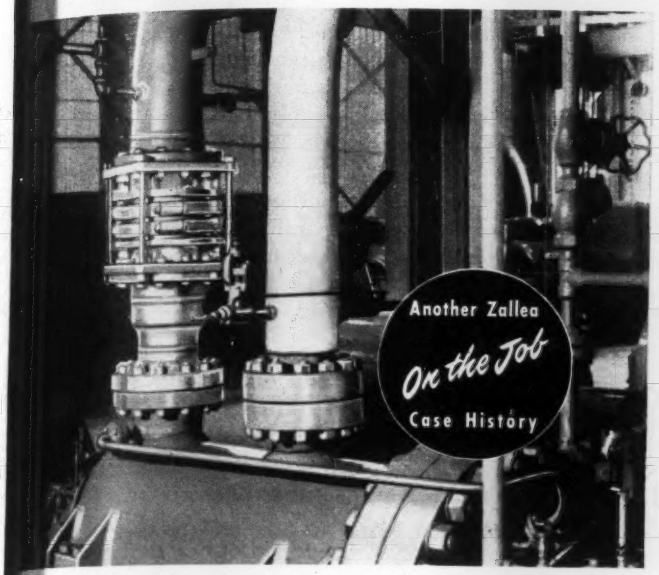
Mr. Scofield describes six types of air cycle systems and briefly discusses possibilities for other applications. Stating that no sweeping superiority can be claimed for the air cycle system, he stresses that fact that while the amount of power required per unit of refrigeration is considerably greater than for the conventional liquid-vapor system, weight and space advantages result in greater overall power savings in aircraft applications. In his opinion, similar advantages exist for other applications such as in the refrigeration of gaseous substances in chemical plants and petroleum separation processes—applications which have never been fully investigated.

Tests Stainless Steel Resistance to Acids

Recently, some tests were conducted to study the corrosion behavior of samples of various grades of stainless steels upon exposure to the boiling nitric acid test (Huey test) in comparison with that of specimens from the same lots of material upon exposure to solutions of other acids.

The test program was made up of two parts. In one of these, specimens of AISI types 304 and 316 stainless steel in both the annealed and sensitized conditions were exposed to the boiling nitric acid test and also to boiling solutions of phosphoric, lactic, and acetic acids in the same type of equipment as that used for the boiling nitric acid test. In the second part of the program, specimens of types 304, 310, 316, 317, 321, and 347 stainless in the annealed condition were exposed to the boiling nitric acid test and also to sulfuric acid of a series of concentrations, temperatures and degrees of aeration.

A report of the tests is contained in the paper, Comparative Corrosion Resistance of Stainless Steels in Various Acids, by R. B. Mears, C. P. Larrabee, and C. J.



Another Zallea Repeat

WHEN West Penn Power Company added No. 7 Unit to its Springdale, Pa., Station in 1945, Zallea Stainless Steel Expansion Joints were installed to provide for expansion of the piping. Three years later, West Penn *again* selected Zallea Joints for use in its new Mitchell Station at Courtney, Pa. And, a second unit at Mitchell, now under construction, is *also* being equipped with Zallea Stainless Steel Expansion Joints.

Here, as in hundreds of cases, satisfied repeat customers continue to specify Zallea when they want the utmost in economy, dependability and long service life. *There's no packing to deteriorate . . . no maintenance required.*

There's a Zallea Expansion Joint for almost every requirement. Available in diameters from 3″ to 72″ for temperatures from sub-zero to 1600°F . . . for pressures from vacuum to 300 psi in standard designs and up to 1000 psi in special designs.

Catalog 47 contains complete information on all Zallea Expansion Joints. We would be pleased to send you a copy. *Write today.* ZALLEA BROTHERS, 816 Locust Street, Wilmington 99, Del.

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WORLD'S LARGEST MANUFACTURERS OF EXPANSION JOINTS EXCLUSIVELY

CASE REPORT NO. 48 from a series of actual cases recording the successful application of BEAR DY-NAMIC BALANCING to Industry.

UNITED STATES ELECTRICAL TOOL CO.
CINCINNATI, OHIO

This manufacturer of electric tools, who has been Bear Balancing fans for armatures, as well as fan and armature assemblies for over five years. Company reports that it takes just 3 to 5½ minutes, depending upon the unit, to obtain perfect Dy-Namic Balance in rotating parts. Up to 135 units per day are now being Bear Balanced at U. S. Electrical Tool Co. Further findings: Bear Dy-Namic Balancing is a fool-proof method of attaining perfect Dy-Namic Balance, one of the major causes for the improved mechanical performance of the finished product. Bear Balancing of rotating parts results in smoother, quieter operation of the balanced object, adding years to the life of the finished machine.

3 of the IMPORTANT PRODUCTION ADVANTAGES which ACCOUNT FOR THE SUCCESS OF BEAR BALANCING

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- **SIMPLICITY** It takes just a few hours to train men or women to operate a Bear Balancer. There are no complicated manipulations to learn.
- **ACCURACY** The dependable precision of Bear Balancers is reflected in the improved performance of the finished product . . . it increases customer acceptance!

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Hundreds of recognized manufacturers in all channels of industry report successful results with Dy-Namic Balancing of rotating bodies, weighing anywhere from 4 oz. to 8 tons. Your specific operation, or one similar to it, is most likely represented in our file of Case Reports. We'll be glad to send you particulars, as well as a copy of the latest Bear Industrial Balancing Catalog. Write Bear Mfg. Co., Dept. H-16, Rock Island, Illinois.

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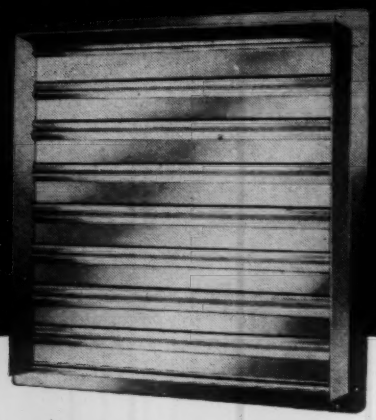
they all want AIR-FLO



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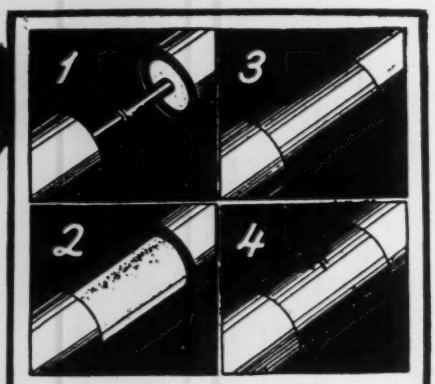

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1. Field joint ready for inspection. 2. Joint covered with standard pipe insulation. 3. Durant joint casing in place ready for asphalt. 4. Asphalt poured in slot making a perfect seal.

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The ORIGINAL Pre-sealed Insulated Pipe

Fetner, all of Carnegie-Illinois Steel Corp. Mr. Mears is manager of the firm's research laboratory and the other two authors are on the technical staff. The report was presented at the recent 52nd annual meeting of the American Society for Testing Materials, 1916 Race St., Philadelphia 3.

Conclusions of the authors indicate that the results of the boiling nitric acid test are influenced by the type of heat treatment given the stainless specimens.

Provides Data on Magnesia Insulation

Properties of 85 percent magnesia insulation, determination of correct thicknesses, application and finishing procedures, and insulation maintenance are some of the topics covered in a 96 page manual published by the Magnesia Insulation Manufacturers Association, 1317 F St., N.W., Washington 4, D. C.

An appendix contains a discussion of practical applications of heat transmission theory, definitions of technical terms, 15 tables of data on 85 percent magnesia and related subjects, and a glossary of trade terms.

Requests for copies should be made to the association on business letterhead, giving the title of the person making the request.

Other Books and Reports Received

Psychrometric Selector—A slide rule type, pocket sized instrument made of heavy cardboard available from Nickerson and Collins Co., 433 N. Waller Ave., Chicago 44. All answers are in figures. The direct reading chart shows relative humidities from 10 to 90 percent, dry bulb temperatures from 32 to 100 F, wet bulb temperatures from 22 to 97 F, and dew point temperatures from —13 to 96 F on one side. The other side gives data on sensible heat, volume of 1 lb or 1 cu ft air, volume of vapor, total heat, grains of moisture, latent heat, and vapor pressure. The price is $1.50.

Insulation, Mineral Wool, Blanket, Felt, and Industrial Batt, Federal Specification HH-I-563—Specifies minimum requirements for the Army, Navy, Maritime Commission, and other government agencies, but should be an important reference for specifying insulation applied to power and process equipment. Free printed copies may be obtained from the Industrial Mineral Wool Institute, 441 Lexington Ave., New York 17.

American Preferred Schedules for Power Circuit Breakers, C37.6-1949 was developed by a committee of manufacturers, users, and engineers especially interested in power switchgear and is said to meet all the usual needs of circuit breaker users and to provide the benefits of standardization. Copies are available at 35 cents from the American Standards Association, 70 E. 45th St., New York 17.

Pipe Fitter's and Pipe Welder's Handbook, by Thomas W. Frankland, instructor, steamfitting dept., Washburne Trade School, Chicago—Sixth edition, $1.25 per copy, published by Bruce Publishing Co., 540 N. Milwaukee St., Milwaukee 1. This is a pocket sized booklet containing 152 pages and giving fundamental information on trade mathematics, pipe fitting calculations, and pipe welding layout. It includes numerous reference tables.

UNITED LoTemp Series --Indoor --Outdoor

- **Tempered Presdwood Casing .. Light Weight . . . Rugged . . . Won't Rust Out**
- **Totally Enclosed Motors**
- **Forced Draft Operation**

All of the above features incorporated in the LoTemp Series. Available from stock in 5, 7½ and 10-ton units.

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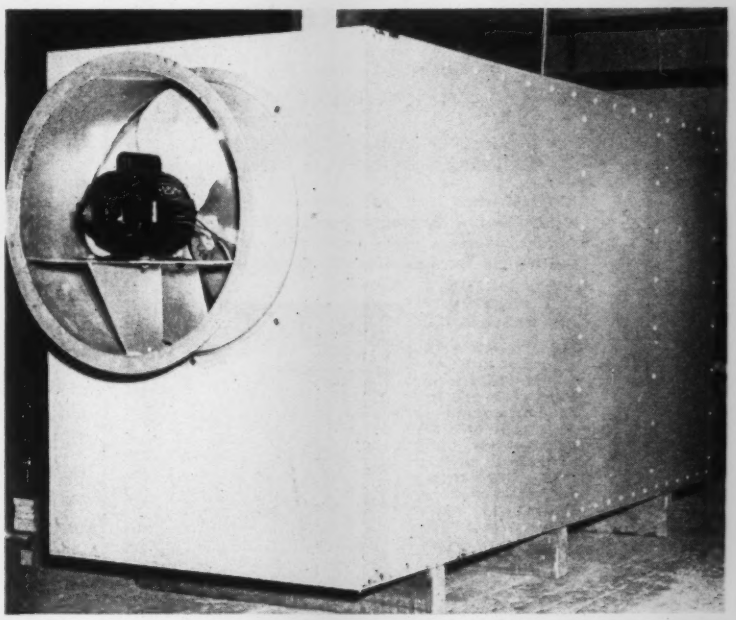

LoTemp 75 . . . 7½ Tons Capacity

UNITED COOLING TOWER CO.

Porter Bldg.
Kansas City 2, Missouri

Send for this Reprint . . .

"DESIGN and CONTROL OF YEAR 'ROUND COMFORT AIR CONDITIONING SYSTEMS"

by William Goodman

In this excellent series of twelve articles, which appeared some time ago in HEATING, PIPING & AIR CONDITIONING, Mr. Goodman offers engineers many refreshingly new slants on how to accomplish the exact results desired from any air conditioning system.

Mr. Goodman first reviews in orderly manner the basic principles governing air conditioning design and control. Then he explains the advantages and disadvantages of different arrangements of equipment and controls in systems used for year 'round service, and shows the results that can be expected from each. It is a series packed with "do's and don'ts" on design that every air conditioning engineer will find of inestimable value in avoiding design errors.

A complete reprint of this valuable series—an 8½" x 11" booklet of 53 pages—is now available for you at only 50 cents per copy. Send your order and remittance to the address below.

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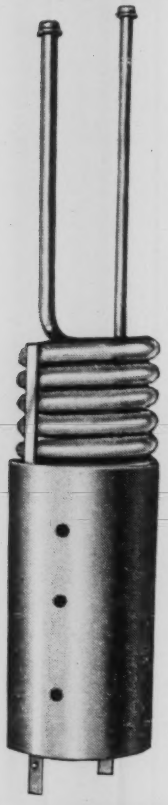

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All-steel shell and coil assembly for preheating heavy liquids to proper flow temperature in bulk storage. Suction pipes, inlet and outlet pipes for heating go through manhole cover.

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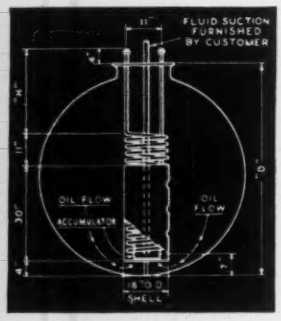
Heats with either steam or hot water. Oil or other liquids enter preheater from the bottom and pass over coils into flow accumulator before entering suction line. Connections furnished for any diameter tank. Made with 14" and 16" diameter shell.



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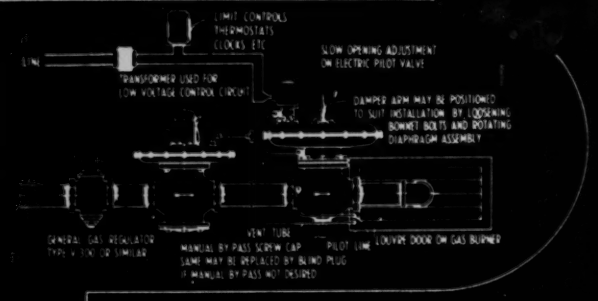
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MEETINGS & CONVENTIONS

Instrument Society of America, 921 Ridge Ave., Pittsburgh 12—The 4th annual conference and exhibit, September 12 to 16, Municipal Auditorium, St. Louis. A preconvention instrument maintenance clinic will be held September 9, 10, and 11 at the Statler hotel.

It is expected that over 10,000 persons will attend the exhibit and that 300 instrument men will participate in the clinic. About 30 technical sessions will be held.

National Association of Corrosion Engineers, south central regional meeting, Adolphus hotel, Dallas, Tex., October 3 and 4. Chairman of the committee on arrangements for the south central region is G. R. Olson, United Gas Pipe Line Co., Box 1407, Shreveport 92, La.

American Society for Testing Materials, 1916 Race St., Philadelphia 3—First Pacific area national meeting, Fairmont Hotel, San Francisco, October 10 to 14. Several technical committees will hold sessions and some 70 technical papers will be presented. Subjects to be dealt with include plasticity and fatigue of metals, dynamic stress determinations, high additive content oils, and turbine oils.

American Welding Society, 33 W. 39th St., New York 18—The 30th annual meeting and exposition will be held in Cleveland, the week of October 16.

As usual, the meeting will be held during the National Metal Congress and Exposition. The society has reserved a block of rooms at the Hotel Cleveland, headquarters for the meeting. When the quota is filled, room applications will be referred to the Metal Congress Housing Bureau.

The 37th National Safety Congress and Exposition, October 24 to 28, Chicago. Sessions on industrial safety are scheduled for the Stevens, Congress, and Morrison hotels. Further information can be obtained from R. L. Forney, general secretary, National Safety Council, 20 N. Wacker Dr., Chicago 6.

2nd Biennial Pacific Chemical Exposition, November 1 to 5, San Francisco Civic Auditorium—A display of natural resources of the 11 western states is to be a featured exhibit at the show which is sponsored by the California Section, American Chemical Society, Whitcomb hotel, San Francisco 1. Marcus W. Hinson is managing the affair.

Ninth Midwest Engineering and Power Exposition—November 11 to 16, Navy Pier, Chicago. George E. Pfisterer, 308 W. Washington St., Chicago, is managing director.

Sixth All-Industry Refrigeration and Air Conditioning Exposition, November 14 to 18, Atlantic City Auditorium—Sponsored by the Refrigeration Equipment Manufacturers Association and managed by R. K. Hanson, show director, 1107 Clark Bldg., Pittsburgh 22. Over 5000 rooms have been pledged by nearby hotels and approximately 75,000 sq ft of exhibition space will be used. Head-

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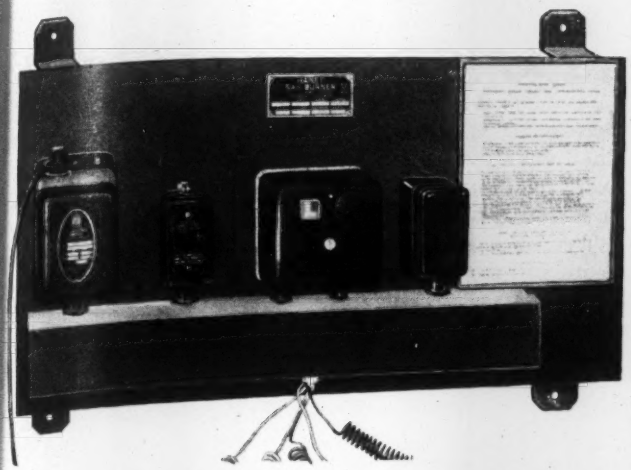

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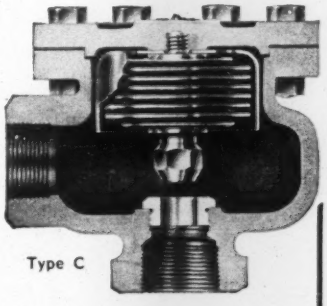

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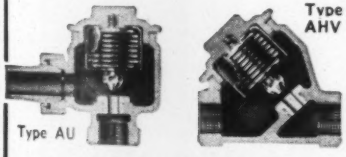

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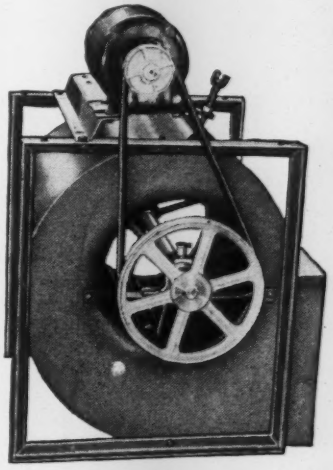

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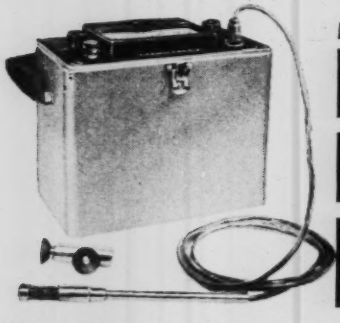

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quarters for cooperating associations are: Traymore hotel, REMA and exhibitors; Claridge hotel, Refrigeration Equipment Wholesalers Association; Ambassador hotel, Refrigeration Service Engineers Society and Refrigeration and Air Conditioning Contractors Association; Chalfonte-Haddon Hall, Air Conditioning and Refrigerating Machinery Association and National Electrical Manufacturers Association.

The exposition will be open exclusively to service engineers and contractors on the first day, November 14.

American Society of Refrigerating Engineers, 40 W. 40th St., New York 18—1949 annual meeting, December 5 to 7, Edgewater Beach hotel, Chicago.

Plant Maintenance Exposition and Conference, January 16 to 19, Cleveland Auditorium—Exhibits and conference subjects will deal with air conditioning, heating, ventilating, building supplies, electrical equipment, employee relations, instruments, lubricants, paints, materials handling, power generation and transmission, welding, etc. Advance registration cards may be obtained from Clapp & Poliak, Inc., 350 Fifth Ave., New York 1, exposition manager.

American Society of Heating and Ventilating Engineers, 51 Madison Ave., New York 10—56th annual meeting, Dallas, Tex., January 23 to 26.

10th International Heating, Ventilating, and Air Conditioning Exposition—Dallas, Tex., January 23 to 27. As in past years, the show will be managed by International Exposition Co., Grand Central Palace, New York City.

Heating, Piping, and Air Conditioning Contractors National Association, 1250 Avenue of the Americas, New York 20—1950 annual meeting, May 8 to 12, St. Francis hotel, San Francisco.

Revises Steel, Horizontal Firebox, Heating Boiler Recommendations

The standing committee for Simplified Practice Recommendation R157-37, Steel Horizontal Firebox Heating Boilers, has approved a revision of this recommendation, and copies have been mailed to producers, distributors, users, and other interests for review.

As first issued in 1937, this recommendation established a uniform list of ratings for steel heating boilers of the horizontal firebox type. Boiler ratings, in terms of steam and water radiation and Btu per hour, were given for both hand and mechanical firing. Other essential basic data included grate area, heating surface and minimum furnace volume for each rating.

The proposed revision will include a simplified and uniform list of ratings for residential steel boilers, oil-fired, in terms of steam and water radiation and Btu per hour. Minimum furnace volume and minimum heating surface are included for these boilers. A method is included to determine the steam, water and Btu net ratings for residential boilers, stoker, hand, and gas fired.

Mimeographed copies of the proposed revision may be obtained from the Commodity Standards Division, National Bureau of Standards, Washington 25, D. C.

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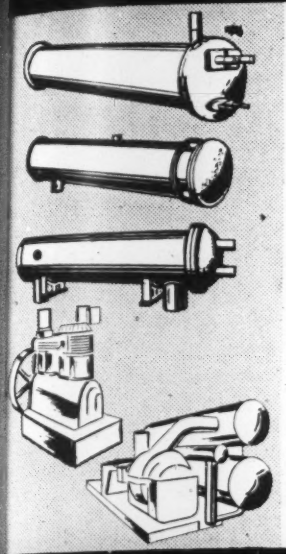

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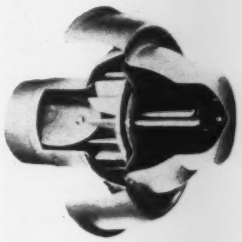

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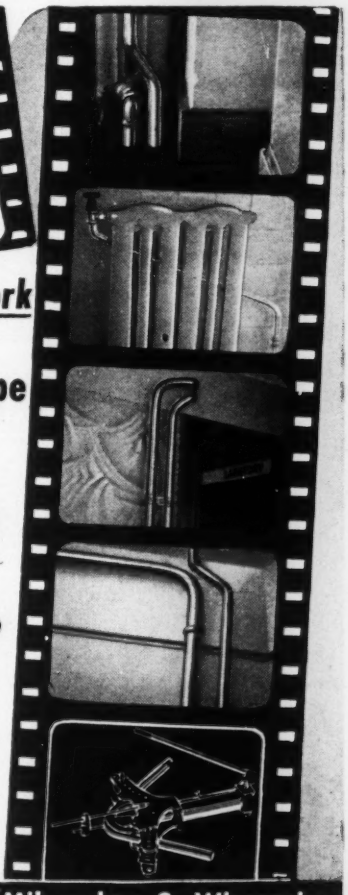

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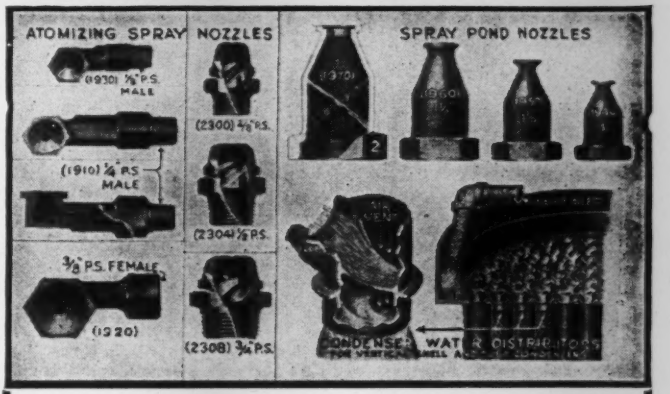

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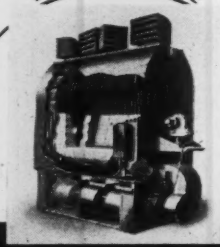

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RECENT TRADE LITERATURE

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No. 7309: Air Conditioning Compressors—Installations of "Eclipse" compressors in connection with air conditioning systems in a laboratory, a restaurant, and a clothing store are described in the Vol. 20, No. 6 issue of the house organ of Frick Co., Waynesboro, Pa.

No. 7310: Air Freshening Case Histories—How "Airkem" is utilized to freshen air in an indoor arena, a large hotel, and in a pharmaceutical plant is the subject of a new folder issued by Airkem Inc., 241 E. 44th St., New York 17.

No. 7311: Air Meter—The "Anemotherm" is an instrument for the measurement of air velocity, temperature and static pressure. It is a self contained, portable unit which is described in Bulletin 25 of Anemostat Corp. of America, 10 E. 39th St., New York 16.

No. 7312: Ammonia Booster Compressor—A vertical type unit, designed for plants which handle a low temperature load as well as a relatively high temperature load, has been developed by Worthington Pump and Machinery Corp., Harrison, N. J., and is described in Bulletin C-1160-B34. It is available in four sizes with ratings from 5 to 50 hp.

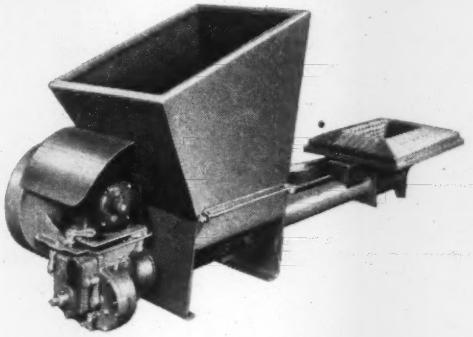
No. 7313: Ammonia Condensers—Of the shell and tube type are described and illustrated in Catalog No. 21-C released by Acme Industries, Inc., Jackson, Mich. In addition to covering design and construction features, the booklet gives dimensions, capacities, and general specifications.

No. 7314: Arc Welding Supplies—Bulletin 467 of Lincoln Electric Co., Cleveland 1, is a directory of its welding supplies and covers a variety of electrode holders, ground clamps, cable lugs, cables, wire brushes, and protective shields.

No. 7315: Blowers and Exhausters—Centrifugal type units for handling air and gases of various densities, temperatures, and chemical compositions are briefly described and illustrated in Bulletin B-5-A of Lamson Corp., Allen Billmyre Div., Syracuse 1, N. Y. A number of models including both single and multi-stage units and heavy duty cast iron types are covered. Sizes range from fractional to 250 hp.

No. 7316: Boilers and Radiation—Burnham Corp., Boiler Div., Irvington, N. Y., has recently issued Catalog No. 81 covering the company's complete line of boilers for all fuels, radiators, "Base-Ray" baseboard heating units, "radiant" radiators, and unit heaters. Ratings, dimensions, and other data are given.

New Series of Stokers by Brownell



These new Type "F" Brownell Screw-Feed Stokers are built in seven sizes. They have coal-burning rates of 75 to 312 lbs. per hour, giving a range of 13 to 93 boiler h.p.

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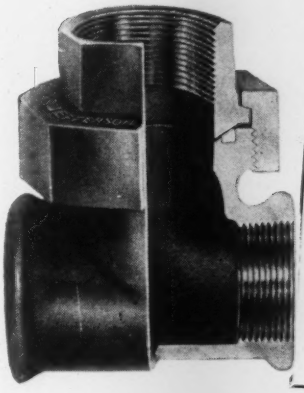

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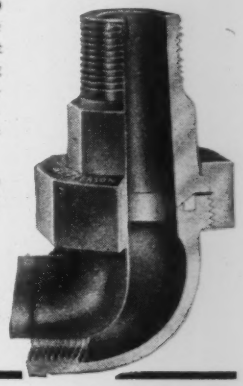

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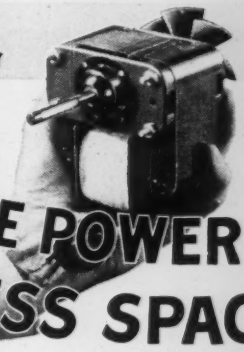

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The Raytheon "350" is precision made—quiet, powerful, with rigid bearing brackets accurately aligned on centerless ground mounting dowels.

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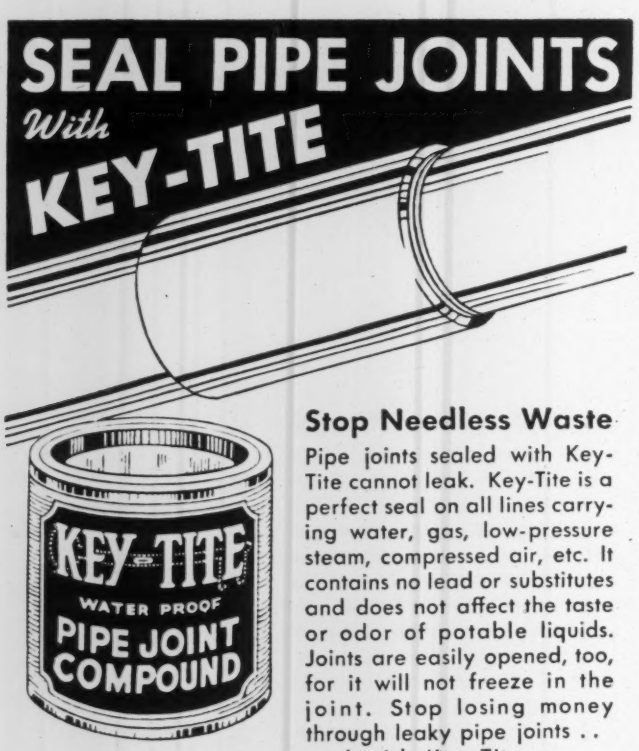

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No. 7317: Cooling Towers—The series of quiz sheets being issued by Marley Co., Inc., Kansas City 10, Kan., contains questions and answers relative to design, construction, and operation. Quiz No. 6 in the series deals with such factors as water distribution, materials for an air tight casing, fan characteristics, accessibility, requirements for a cold water collecting basin, and drift eliminators.

No. 7318: Electric Motor—A heavy cast iron frame surrounding all working parts, a double insulated stator, a die cast rotor, drip-proof end brackets, and prelubricated bearings are some of the features of "Safety-Circle" motors described in Bulletin 51B-6210B of Allis-Chalmers Mfg. Co., 1171 S. 70th St., Milwaukee. Drip-proof and splashproof motors are offered in sizes from 1 hp at 1800 rpm to 20 hp at 3600 rpm, in frames 326 and smaller. Units are also available in totally enclosed, nonventilated, totally enclosed fan cooled, and explosionproof types.

No. 7319: Expansion Joints—Cook Electric Co., 2700 N. Southport Ave., Chicago 14, is now issuing weekly newsletters on its products, developments, and manufacturing methods. Issue No. 2 describes installations of "Magni-Lastic" expansion joints in a large cold storage warehouse. The Vol. 2, Issue No. 4 pamphlet describes how each joint is individually tested.

No. 7320: Expansion Joints—Design Guide to Expansion Joint Selection and Application is the title of a new 28 page booklet released by Chicago Metal Hose Corp., Maywood, Ill. Written in nontechnical language and containing numerous illustrations, it is said to simplify the selection of the company's joints for various conditions of temperature, pressure, etc. Copies will be furnished to those who have a direct interest and who indicate their company affiliation and title or function.

No. 7321: Flow Meter—Bulletin 400-F2, released by Builders-Providence, Inc., Div. of Builders Iron Foundry, Providence 1, R. I., gives detailed information on the model SMDH "Shuntflo" meter for steam, air, or gas. Design and construction features, operation, calibration, capacity tables, correction factors, and a typical accuracy curve are included. It is designed for direct installation in 1 or 1½ in. lines. A similar bulletin (No. 400-F1) describes the model SMKS meter which may be used with pipe lines from 1 to 12 in. in diameter.

No. 7322: Gas Measuring and Mixing—Controls for measuring and mixing both manufactured and natural gas are covered in a new bulletin released by Cutler-Hammer, Inc., 421 N. 12th St., Milwaukee 1. Units described include one for recording the calorific value of any gaseous fuel, a "Calorimixer" for mixing gases, and a "Thermeter" for measuring gas in small plants.

No. 7323: Infrared Electric Radiant Heaters—Featuring inconel sheathed tubular heating elements and parabolic reflecting surfaces, "Chromalox" units are described in Bulletin CS-603 issued by Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh 8. A series of single page reports covering various industrial drying, baking, and heating applications are also available.

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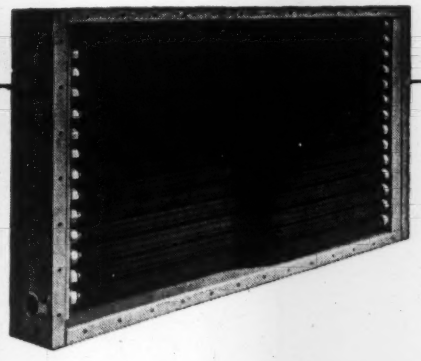

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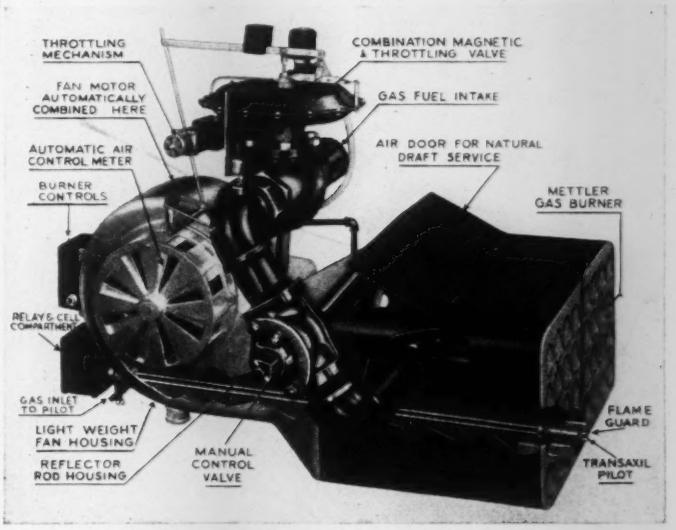

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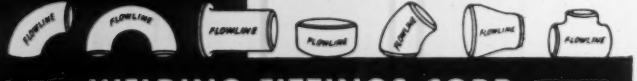

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No. 7324: Instantaneous Water Heaters—A new six page bulletin (No. 70) on "Paracoil" units has been issued by Davis Engineering Corp., 1064 E. Grand St., Elizabeth 4, N. J. Capacity and dimension tables for two, four, and six pass heaters are given and a typical piping hookup is shown. All designs use ⅝ in. copper tubes bent into U shape and rolled into steel tube sheets. The liquid to be heated passes through the tubes and the heating medium, steam, through the shell.

No. 7325: Low Temperature Brazing—Case histories showing how several manufacturers use "Easy-Flo" and "Sil-Fos" silver brazing alloys are included in the No. 46 issue of the house organ published by Handy & Harman, 82 Fulton St., New York 7.

No. 7326: Magnesia Insulation—The Vol. 3, No. 3 issue of the house organ published by Magnesia Insulation Manufacturers Association, 1317 F St., N.W., Washington 4, D.C., leads off with an article by H. E. Rose, plant superintendent, Newport Industries, Inc., which describes the use of 85 percent magnesia insulation in this large naval stores plant used for the production of turpentine, pine oil, and rosin.

No. 7327: Metal Framing, Hangers, and Supports—Unistrut Products Co., 1015 W. Washington Blvd., Chicago 7, has released Catalog No. 500 on its equipment for constructing frames, hangers, and supports for heating, piping, air conditioning, electrical equipment, etc. Detailed information on channels, nuts, bolts, screws, concrete inserts, beam clamps, pipe clamps, pipe hangers, roller pipe supports, cable clamps, brackets, and various fittings is given. Photographs of a number of installations are included.

No. 7328: Preventing Water Marks on Aluminum—Stating that water marks will occur only when water is allowed to stand against the material for prolonged periods, the feature article in the No. 10 issue of the house organ published by Reynolds Metals Co., 2500 S. Third St., Louisville 1, gives recommendations for preventing these marks. Information on shipping, storing, and stacking is included along with a discussion on removing watermarks.

No. 7329: Process Measurement and Control—The complete line of "Dynalog" instruments of Foxboro Co., Foxboro, Mass., is described in Bulletin 427. The principle of operation is explained, details of construction are given, and auxiliary devices are described.

No. 7330: Propeller Fans—The use of propeller fans in industrial, commercial, and institutional buildings is described in a 12 page booklet (Bulletin 3146) available from Herman Nelson Corp., Moline, Ill. Features of the company's six basic models are presented and numerous installations are pictured.

No. 7331: Properties of New Glycols—Carbide and Carbon Chemicals Corp., Unit of Union Carbide and Carbon Corp., 30 E. 42nd St., New York 17, has published an eight page booklet, Form 6719, which gives information on uses and properties of eight new glycols. Uses are tabulated by product and industry.

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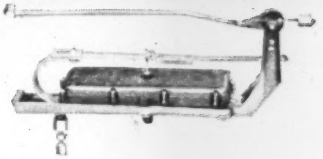

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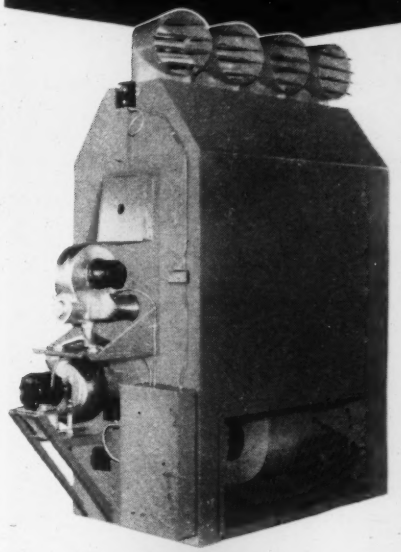

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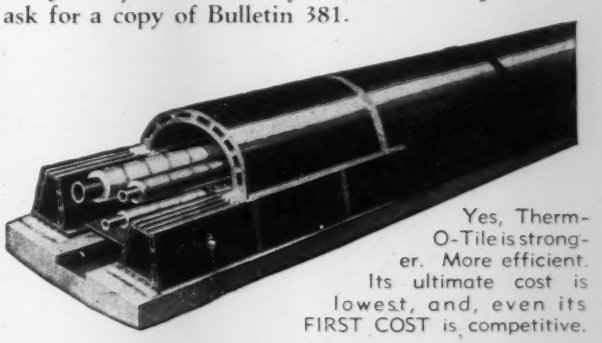

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